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COST MODEL FOR HYDRAULIC GENERATION

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ABSTRACT

It is widely assumed that spending requirements of a hydraulic generating plant depend on its past and current performance and age. In an attempt to establish these relationships, simple correlations were calculated between costs on the one side, and performance and age on the other. Three types of costs were identified: maintenance cost, operating cost, and the cost of capital modifications. Mathematical models were established based on the linear regression technique. The results showed no significant association between cost and performance indicators, but correlations were found between the various costs and the age of plants. The cost-age functions all have a constant term and a quadratic term, and some also a linear term.

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To: Dr. D. Mills
Director of Research

COST MODEL FOR HYDRAULIC GENERATION

1. INTRODUCTION

It is known from past experience that spending requirements of a hydraulic generating plant is influenced by its past performance and age. The concept of a hydraulic generation cost model was initiated by the Hydraulic Generation Performance and Comptrollership Department (HGP&C), as an effort to establish a relationship among cost, performance and age of generating stations. The HGP&C Department requested the Statistics Unit to develop mathematical models associating costs with age and performance indicators of a hydraulic plant. From preliminary work/1/, results showed that an Ontario Hydro hydraulic generation performance indicator, the Incapability Factor (ICbF), is related to time and to the reciprocal of the projected cost indicator, Equipment and Material (E&M) Expenditure.

Since confidence on the validity of the projected E&M Expenditure could not be established, it was suggested instead to use U.S. hydraulic plants data for analysis. The availability of the cost and performance information from U.S. hydraulic plants made a preliminary evaluation possible. Preliminary analysis similar to the earlier one was performed on the U.S. hydraulic data to determine any association. It was found that simple correlations involving cost data (maintenance, operating, and historical cost) and performance data (forced outages, forced deratings, scheduled outages, and scheduled deratings) showed no significant association. However, correlations were found between the costs and the age of a hydraulic plant. Thus, unlike the previous findings on Ontario Hydro hydraulic plants data, U.S. hydraulic plant data displayed association between cost and age only. Therefore, the hydraulic generation cost model is concentrated on the association between cost and age of a hydraulic plant.

The cost data was compiled from a yearly publication of the Energy Information Administration of the U.S. Department of Energy on "Historical Plant Cost and Annual Production Expenses from Selected Electric Plants" and the performance data was provided by the North American Electric Reliability Council.

The SAS (Statistical Analysis Systems) STAT software package was used to perform the statistical computations in the analysis.

2. THE DATA

The cost information included in the U.S. hydraulic utilities data consists of the historical cost, the maintenance cost and the operating cost of a plant. It also contained information on the plant's installed generating capacity, it's net generation, load factor and other plant characteristics. Data were gathered from the 1972 through 1985 publications with number of plants in the yearly sample ranges from 252 to 430. These were recorded and stored in a DBASE data file for later analysis. The cost figures were adjusted from American dollars of the year to 1987 Canadian dollars.

There are three major cost types associated with plant operation. These are the maintenance cost, the operating cost and the cost for capital modifications. The historical cost described in the publication is the net cumulative-to-date actual outlays or expenditures for land, structures, and equipment. Therefore, the cost of capital modifications for a plant was calculated by taking the difference of the historical cost for the current and previous year. Moreover, for costs to be comparable between plants, these have to be normalized. The normalizing procedure could be done by dividing the cost figures by a unique plant characteristic such as the plant's installed generating capacity, its net generation or by its number of units. Normalization by the plant's installed generating capacity was selected because it displayed less fluctuation in the cost values. This enables the cost figures expressed as costs in $/kW.

The data considered for analysis was not the raw data itself but an averaging was done on the unit costs at one year age increment. This was done to derive the average unit cost of maintenance and operation of a hydraulic plant at a certain age group. The plant age groups starts from 0 through 75 incremented by one unit. The lower limits were assigned as values to represent the age of a hydraulic plant. This was the final data considered for the analysis. It should be remembered, that when the maintenance, operating or capital modification costs of a hydraulic plant at a certain age is referred, it is by definition the average maintenance, operating or capital modification costs of plants at that age group.

Since it is of interest how these cost types respond to the age of the hydraulic plant, five models were developed. One model for each of the cost type, a model for the maintenance and operating cost and a model for the total cost. The operating cost model has the largest R-square value among the five models.

3. ANALYSIS AND RESULTS

3.1 The Maintenance Cost Model

The maintenance cost was first considered for establishing a relationship with the plant's age. A scatter plot of the maintenance cost with age in figure 1 displays an increasing trend in the cost as a plant gets older. A simple linear regression was performed on maintenance cost denoted by MTCE (in $/kW) with AGE (of plant). Results in table 1 give a significant F-value of 385.059 at 0.0001 level of significance. This suggests strong evidence that AGE largely contributes to the model. The R-Square value also suggests that the variability of MTCE cost is explained by the variability of AGE by 83.88 percent. From figure 1, however, a quadratic trend is noted between MTCE and AGE. To determine if the addition of a quadratic term, the square of the age

(AGE2), improves the model, a regression model was again performed. Results in table 2, give a R-Square of 91.53 percent. This suggests that AGE2 should be included in the model. It was also found that the model could be further reduced with only AGE2 present because AGE does not have a significant contribution with AGE2 already in the model. Also, by excluding AGE from the model, it eliminates possible problems of collinearity.

Finally, a regression was performed on MTCE and AGE2. In table 3, results show a significant F-Value of 786.598 at 0.0001 level of significance and R-Square of 91.40%. A slight reduction is observed in the R-Square due to a lesser number of predictors but its difference from that given by the previous model is very small. From the above discussion the regression model,

$$MTCE = A + B * AGE^2 + e$$

with estimates for A = 2.353971 and B = 0.001155, was therefore selected as the maintenance cost model. This suggests that maintenance cost of a hydraulic plant increase exponentially with age.

Based on this model, fitted values can be calculated using the formula, FITTED=A+B*AGE2. These are given in table 4. Also, a graph of the observed and fitted values of the maintenance cost with age is shown in figure 2. From the given data, a plant at age 40 has a maintenance cost of $3.97/kW. The expected or fitted maintenance cost value at the same age is $4.20/kW. Also, 95 percent prediction intervals were constructed (See table 4). These intervals give upper and lower limit values which suggest that in a hundred separate random samples, 95 times the value of maintenance cost will fall within the range. The corresponding 95% lower and upper prediction limit values for plant at age 40 are $2.98/kW and $5.43/kW, respectively. A graph showing the observed, fitted, upper and lower limit values with the square of age is given in figure 3. The graph may appear to have a few zero values especially for age of the plant less than five years. This may only be so because of the wide range of values of AGE2.

For a regression model to be sound and valid however, it is essential that the underlying assumptions are met. These are the assumptions for independence and normality of the residuals or error terms, *e*. The residual is calculated by taking the difference between the observed and the fitted values. The independence assumption can be checked by a visual inspection of a residual plot. This is a plot of the residuals with the fitted values or a plot of the residuals with one of its predictors. Figures A.1 and A.2 of Appendix A are residual plots which show a random display of these residuals. Also, the normal probability plot in figure A.3 is approximately a straight line. These suggest that the residuals satisfy the required assumptions for the validity of the model.

3.2 The Operating Cost Model

In the initial stages of operation, the operating cost of a hydraulic plant are expected to be higher due to commissioning and testing. For the purpose of reflecting only the true cost behaviour of a plant under normal operation, the operating costs up to four years of operation was truncated from the operating cost data. A scatter plot of the rest of the operating costs with age is shown in figure 4.

From figure 4, it is observed that the operating cost increases with age with a slight curve trend. Therefore a regression was first performed on the operating cost denoted by OPER with AGE and AGE2. The ANOVA table in table 5 gave a significant value of 882.561 and an R-Square of 96.29%. The t-tests for individual parameters gave p-values of less than 0.05 which suggest that both predictors have significant contribution to the model when already adjusted for the other

predictor. Since AGE and AGE2 are correlated, collinearity may pose a problem. If the model is used for the purpose of prediction, collinearity is of little concern, however, caution must be observed when the model is used for estimation. Before any further inference is made, a check for the residual assumptions was performed. The residual plots in figures B.1 and B.2 in Appendix B display no obvious pattern. These suggest independence in the residuals. For the normality assumption, the W:Normal statistic of 0.95182 has a p-value of 0.0211 (see table B.1). This indicates that the test is significant and therefore the null hypothesis of normality is rejected. In the case where an assumption is not satisfied, often the diagnostics will involve transformations on either the response or the predictor variables. One transformation method for correcting the normality problem in the residuals is presented by Box and Cox/2/. The method involves finding the best transformation for the response variable by maximizing a log-likelihood function L(a). The L(a) function was computed for selected values of a (See Table B.2). From the results of the computations, a=1/2 was selected. This indicates that a square root transformation on the response variable is the most appropriate transformation in correcting the normality problem on the residuals.

To test the independence assumption of the residuals, residual plots were constructed. Figures B.1 and B.2 show no obvious pattern in the residuals and therefore residuals are independent. The test statistic for normality of residuals in table B.3 indicates the assumption is satisfied.

A square root transformation was performed on the response variable, OPER which will be denoted by SOPER, with AGE and AGE2 as predictors. Results in table 6 show a significant F-Value of 851.875 at 0.0001 level of significance. The R-Square value indicates that AGE and AGE2 accounts for the variability in SOPER by 96.16%. Based on the square root transformation, in table 7, a plant at age 40 is expected to have a square root value for the operating cost of 2.137. By taking the square of this, it is equivalent to an expected operating cost of \$4.57/kW. The 95% prediction lower and upper limit values for SOPER are 1.94 and 2.33, respectively. These are equivalent to the 95% prediction lower and upper limits for operating cost of \$3.76/kW and \$5.43/kW. Figures 5 and 6 show the corresponding OPER values based on the square root transformation. Figure 5 gives the observed and fitted values of the operating cost and figure 6 displays the 95% prediction intervals of the operating cost based on the estimates of the said transformation. Based on the results above, the following model,

$$SOPER = A + B_1 * AGE + B_2 * AGE^2 + e$$

with estimates for A = 1.327793, B_1 = 0.017274 and B_2 = 0.000074 is the recommended operating cost model.

3.3 Maintenance and Operating Cost Model

It is of interest to find out how strong is the association between the combined maintenance and operating costs and the age of a hydraulic plant. This cost will be denoted as MNOP. A chart of the maintenance and operating costs with AGE is shown in figure 7. Again a quadratic trend is observed, but a regression was performed on MNOP with AGE and AGE2 as predictor variables. The Analysis of Variance (ANOVA) table in table 8 gave an R-Square value of 95.67%. This means that AGE and AGE2 accounts for the variability in MNOP by 95.67%. The t-test statistic for AGE indicates that AGE does not contribute largely to the model with AGE2 already present. Therefore, it is recommended to reduce the model with AGE2 as its only predictor whereby also, eliminating the problem of collinearity. In table 9, the F-Value of 1629.928 is significant at 0.0001 level of significance. The model has a R-Square value of 95.66%. Therefore, the model,

$$MNOP = A + B_1 * AGE^2 + e$$

with estimates for A = 4.831740 and B_1 = 0.002388 (see table 9) is recommended as the maintenance and operating cost model. This indicates that the maintenance and operating cost increase exponentially with age. The fitted values and 95% prediction limits were constructed. These are given in table 10. Figure 8 shows the observed and fitted values of MNOP with AGE. Figure 9 shows 95% prediction limits with AGE2. Again, the graph may appear to have a few zero values especially with age of plant less than five. This may appear to be so because AGE2 have a wide range of values. From this graph or Table 10, the observed maintenance and operating cost of a plant at age 40 is \$9.58/kW and the fitted value comes to an \$8.65/kW. The 95% prediction limit values are \$6.89/kW and \$10.41/kW which gives the interval range where values of random samples will fall 95% of the time.

To validate this model, the assumptions of independence and normality are checked. The residual plots in figures C.1 and C.2 of Appendix C display no obvious pattern among the residuals. These suggest independence among the residuals. Also, the test statistic for normality of residuals in table C.1 indicates that the normality assumption is satisfied.

3.4 The Cost of Capital Modifications

Plant costs would also include the type of costs responsible for new equipments, for upgrading civil structures, etc. These type of costs are categorized under the cost of capital modifications.

The cost of capital modifications denoted by CAPL was derived from the historical cost available from the publications. It was observed that in the initial years of operation, this cost is extremely large due to the initial expenses of building a plant. Again, since it was desirable to reflect the costs under normal plant operation, the first four years of data was truncated from the data. The graph in figure D.1 shows the cost of capital modifications with age. Compared to the maintenance and operating cost, the cost of capital modifications is more scattered and have extreme values. By inspection, the CAPL values at age group 30, 58 and 61 appear to be extreme values or outliers. When extreme CAPL values occur in an age group, it is suspected that a particular plant in that age group may have added a unit that causes an inflated CAPL value. When this occurs, a re-estimation of the CAPL value is made by excluding a plant with severely large CAPL value in the averaging procedure for that age group. In order to determine whether statistical outliers are present, first, a regression was done on CAPL with AGE and AGE2. Then, the test statistic, RSTUDENT, from the outlier test was generated for each CAPL value. The absolute value of RSTUDENT must be greater that $t(68,0.01)$=4.03 (See table E of Attachment I) in order for the CAPL values to be considered as statistical outliers. In table D.2, the CAPL values of \$28.1/kW and \$41.87/kW at age group 30 and 61, respectively, were found to be statistical outliers. With discretion, the CAPL values of individual plants at age group 30 and 61 were checked and a plant with severely large CAPL value was eliminated from the averaging procedure. The results of this re-estimation gave new CAPL values at age group 30 and 61 of \$1.49/kW and \$1.83/kW, respectively. Again, a regression was done and the RSTUDENT values were generated to check for new outliers. Results in table D.4 showed that the CAPL value of \$20.56/kW at age group 58 is an outlier. Similar re-estimation procedure was conducted and the resulting new estimate for the CAPL value was \$3.96/kW. Finally, another regression was performed and RSTUDENT values (See table D.7) were generated, this time no outliers were found.

The scatter plot of the capital modifications with re-estimated CAPL values versus age is shown in figure 10. In table D.5, the F-Value of 23.568 is significant at 0.0001 level of significance. The R-Square indicates that AGE and AGE2 accounts for the variability in CAPL by 40.94%. This is considered a relatively weak correlation of AGE and AGE2 with CAPL, but the t-test for individual parameters showed that AGE and AGE2 have a significant contribution to the model.

To check the independence assumption, residual plots were constructed. In figures D.2 and D.3, residuals become more dispersed as the values in the x-axis increase. This picture indicates a non-constant variance problem among the residuals. Also, the residuals do not follow a normal distribution as indicated by the results in table D.6.

To correct the non-constant variance problem, a variance stabilizing transformation is usually performed. The Box & Cox Method/2/ can again be used to select the most appropriate variance stabilizing transformation for the response variable, CAPL. Results in table D.6 indicate that a logarithmic transformation on the response variable, CAPL, is the appropriate transformation in correcting for residual assumptions.

Regression was again performed on the transformed response variable ln(CAPL) denoted by LCAPL with AGE and AGE2. Table 11 shows a significant F-Value of 21.134 at 0.0001 level of significance. The R-Square of 38.33% suggests that AGE and AGE2 accounts for 38.33% of the variability in LCAPL. Also, the individual t-test for AGE and AGE2 shows that both have a significant contribution in the model. It is possible that since AGE and AGE2 are correlated, the problem of collinearity may occur. If the model is used for prediction, collinearity is of little concern, caution must be observed however, when the model is used for estimation. From table 12, a plant at age 40 incurs \$3.52/kW for the cost of capital modifications. The fitted value of LCAPL at this age group is 0.87513. Its CAPL value equivalent is \$2.4/kW which was derived by taking the exponential value of 0.87513. The 95% prediction limit values of LCAPL at age 40 are -0.3786 and 2.12886, respectively. The 95% prediction limit intervals for its corresponding CAPL values are \$.68/kW and \$8.4/kW, respectively. Figure 11 shows the fitted and observed values of CAPL with AGE based on the logarithmic transformation. Figure 12 shows its corresponding 95% prediction intervals.

The recommended capital modifications cost model (See table 11) is,

$$LCAPL = A + B_1 * AGE + B_2 * AGE^2 + e$$

with estimates for A = 1.805956, B_1 = -0.061756 and B_2 = 0.000962.

This time the residual plots in figures D.4 and D.5 show no obvious pattern and therefore satisfies the independence assumption. Also, the normality assumption for residuals is satisfied from the results of table D.9.

3.5 The Total Cost Model

The total cost contains the maintenance cost, the operating cost and the cost for capital modifications. The total cost will be denoted by COST. A chart is given in figure 13 to show the total cost composition.

Again, a regression was performed on the total cost with AGE and AGE2 as predictors. Table 13 gives a significant F-Value of 151.371 at 0.0001 level of significance with R-Square value of 81.66%. This means that the variability of AGE and AGE2 accounts for 81.66% of the variability in COST. Also, the t-test for individual parameters showed that AGE and AGE2 have significant contributions into the model even after adjusting for the other predictor.

The test for the independence assumption revealed a non-constant variance problem as depicted in the residual plots in figures E.1 and E.2. The residuals are not random but display an increasing pattern as the values in the x-axis increase. The normality assumption is also not satisfied from the results in table E.1. To correct the non-constant variance problem, the Box and Cox Method/2/ was again used to find the best a that maximizes the log likelihood function $L(a)$. Results in table E.2 indicates a logarithmic transformation on the response variable, COST.

A logarithmic transformation was done on COST and is denoted by LCOST. A regression was performed. The ANOVA table given in table 14 have F-Value of 164.304 and R-Square of 82.85%. The t-test for the AGE parameter is not significant. This means that AGE does not contribute largely in the model with AGE2 already present. This result allows reduction of the model with AGE2 as its only predictor. Again a regression was performed on LCOST with AGE2. The ANOVA table in table 15 gives a significant F-Value of 324.968 at 0.0001 level of significance. The variability in COST is explained by the variability in AGE2 by 82.49%. The total cost of a plant at age 40 is \$13.10/kW. The fitted value of LCOST at age 40 from table 16 is 2.46896. This is equivalent to a COST value of \$11.81/kW. Figure 14 gives the plot of the observed and fitted values of COST based on the logarithmic transformation. The 95% prediction limits of LCOST from table 16 are 2.09838 and 2.83953, respectively. The 95% prediction limits of the corresponding CAPL values are \$8.15/kW and \$17.11/kW, respectively. The prediction intervals of COST based on the transformation are shown in figure 15. Therefore the model,

$$LCOST = A + B_1 * AGE^2 + e$$

with estimates $A = 2.093715$ and $B_1 = 0.000235$ is the recommended Total Cost Model. This indicates that the logarithm of the total cost increase exponentially with age.

Finally, to verify the independence assumption for this model, residual plots were constructed. In figures E.4 and E.5 of the Appendix E, residuals display no obvious pattern, therefore the independence assumption is satisfied. Also, results in table E.3 show the normality assumption for residuals is satisfied.

4. CONCLUSIONS

The results of the study have established regression models for the maintenance cost, operating cost the cost for capital modifications and the total cost. These are summarized below.

- The fitted equation of the recommended maintenance cost model is,

  $$Maintenance\ Cost = 2.354 + 0.001155 * Age^2$$

  with R-Square of 91.40%.

- The fitted equation for the recommended operating cost model is,

$$Sqrt(Operating\ Cost) = 1.328 + 0.017274 * Age + 0.000074 * Age^2$$

with R-Square of 96.16%.

- The fitted equation for the recommended maintenance and operating cost is,

  $$Maintenance\ \&\ Operating\ Cost = 4.832 + 0.002388 * Age^2$$

  with R-Square of 95.66%.

- The fitted equation for the recommended capital modifications cost model is,

  $$ln(Capital\ Modification) = 1.806 - 0.061756 * Age + 0.000962 * Age^2$$

  with R-Square of 38.33%.

- The fitted equation for the recommended total cost model is,

  $$ln(Total\ Cost) = 2.094 + 0.00235 * Age^2$$

  with R-Square of 82.49%.

It can be seen from the models that costs are functions of the age and the square of age.

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Reliability & Statistics Section

TCO:cmh

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2. Weisberg, S., "Applied Linear Regression", John Wiley & Sons, 2nd Ed., 1985.

US HYDRAULIC UTILITIES
MAINTENANCE COST

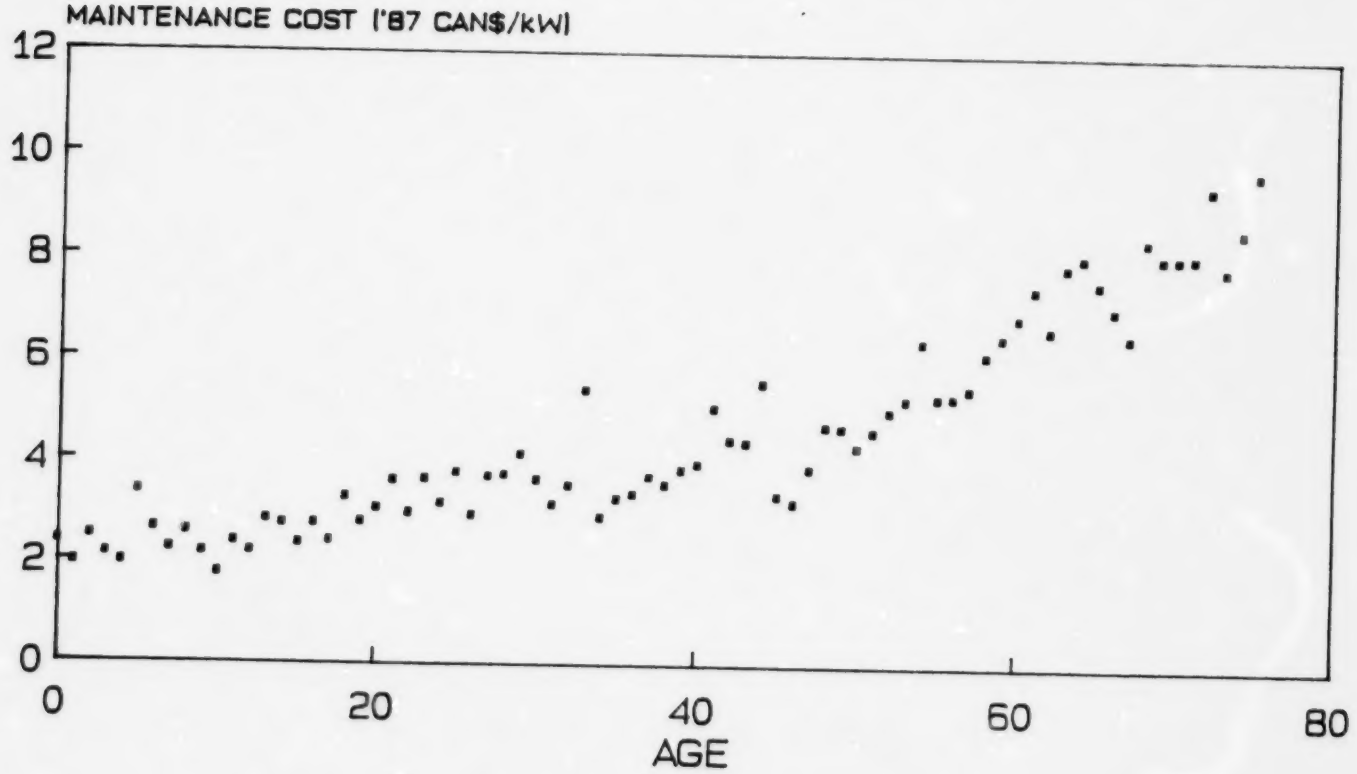

Figure 1

US HYDRAULIC UTILITIES
MAINTENANCE COST vs AGE

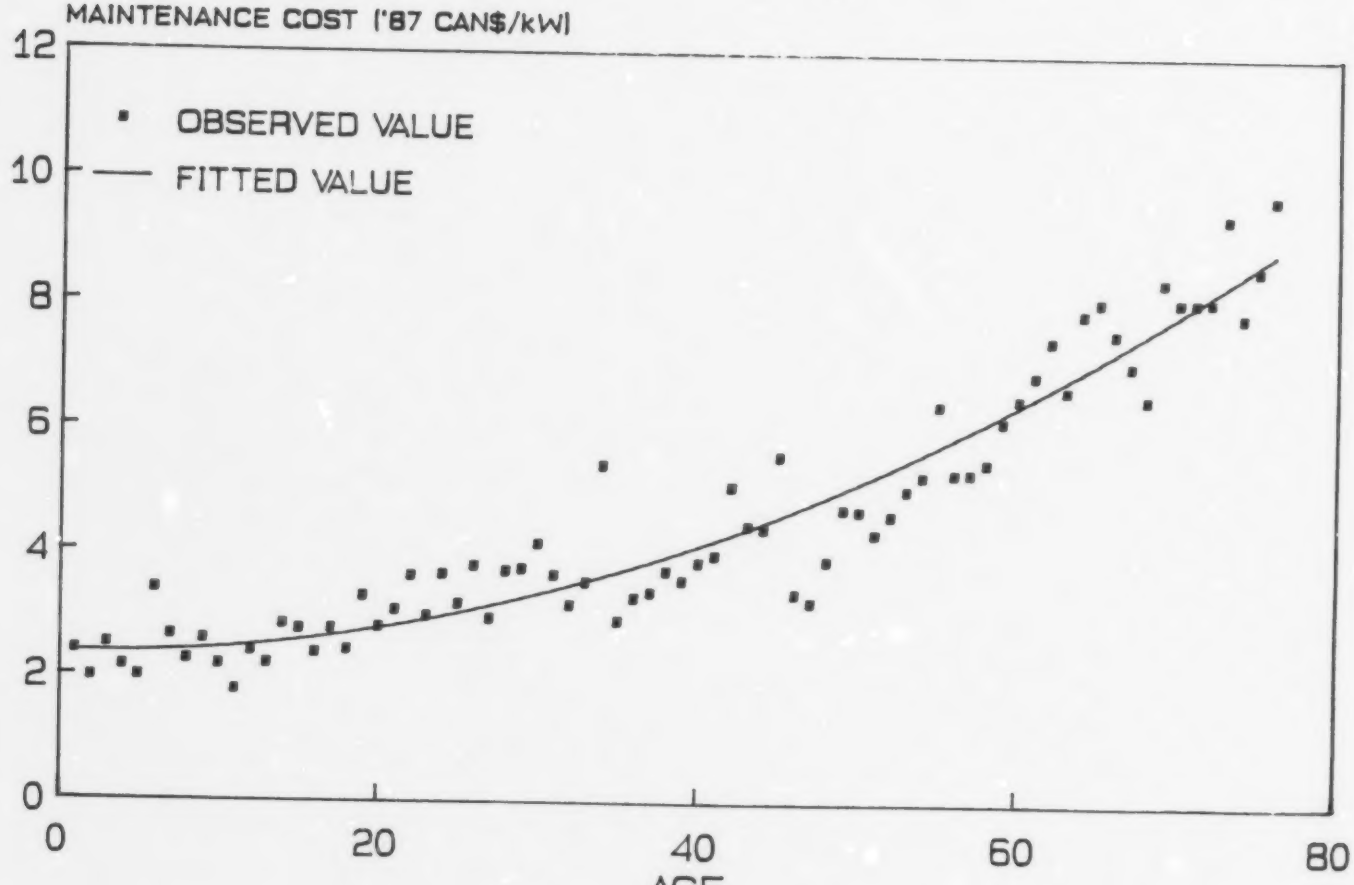

Figure 2

95% PREDICTION INTERVALS

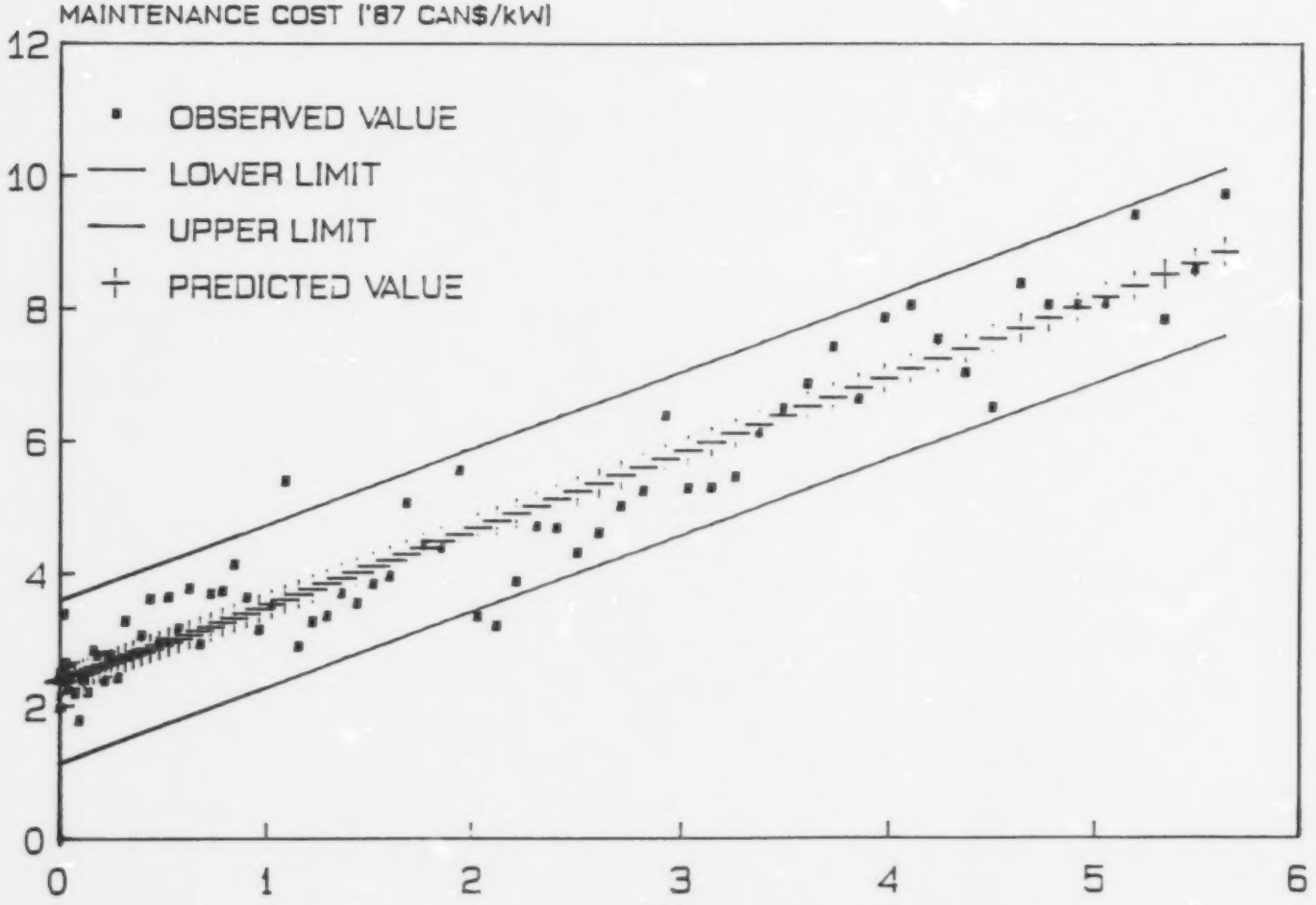

Figure 3

US HYDRAULIC UTILITIES
OPERATING COST

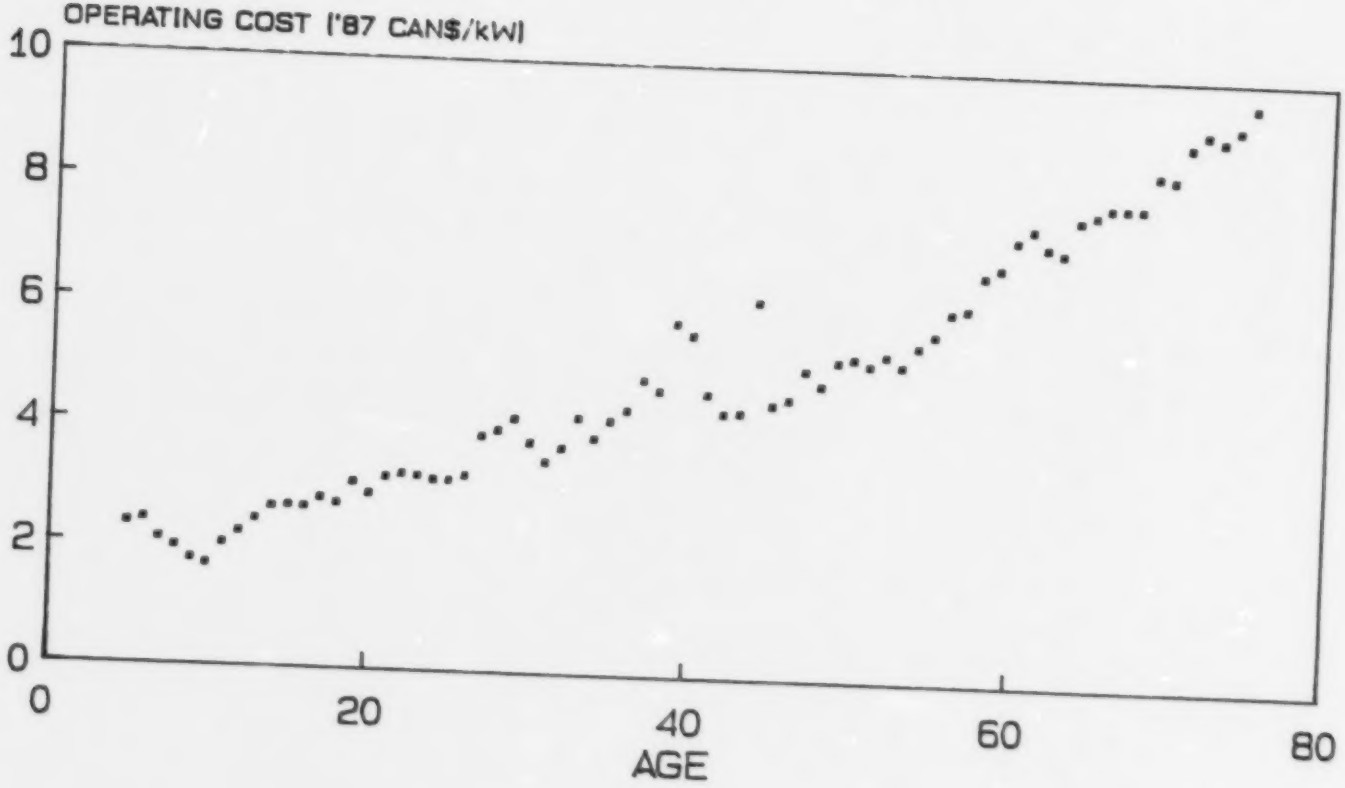

Figure 4

US HYDRAULIC UTILITIES
OPERATING COST VS AGE

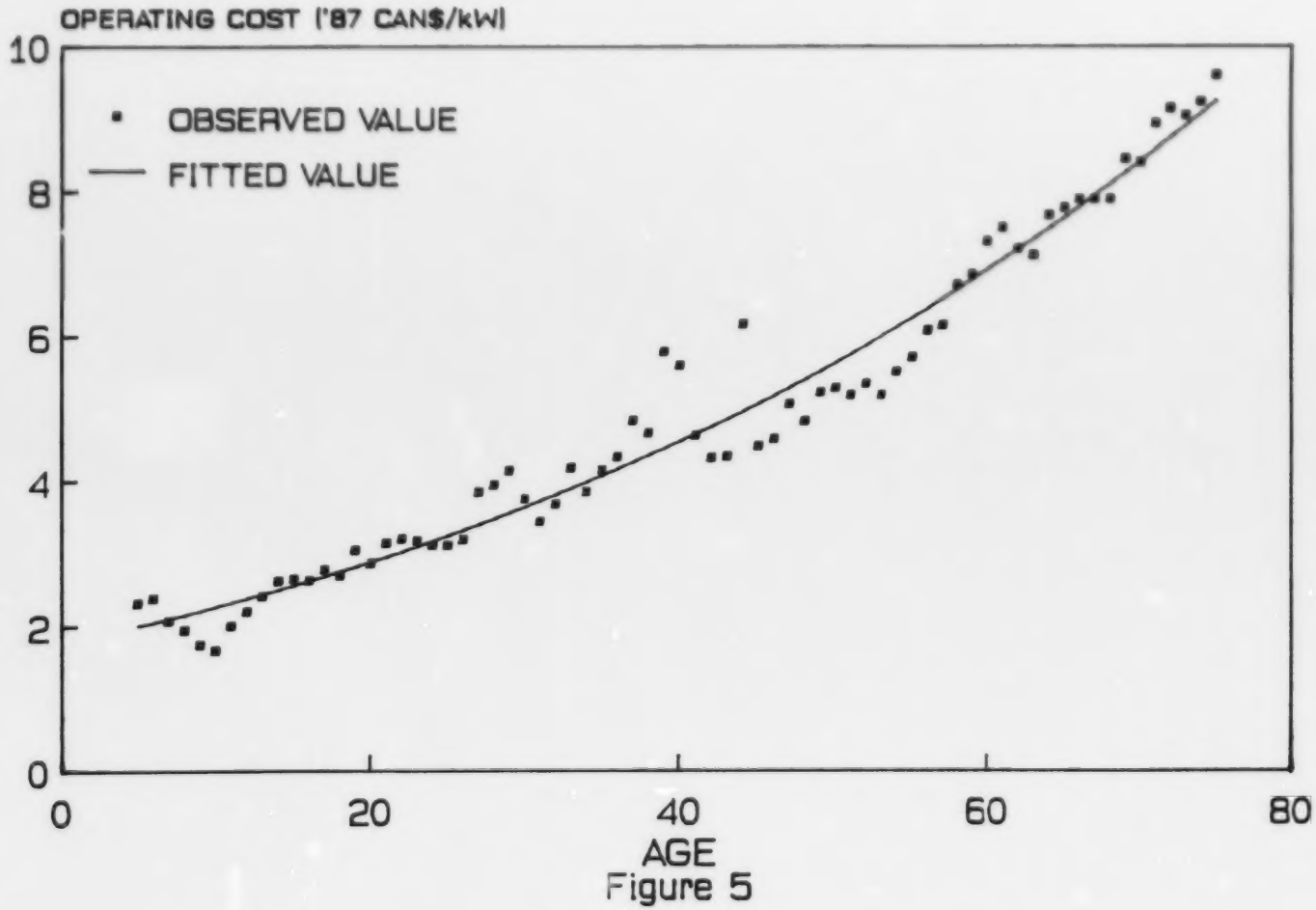

Figure 5

95% PREDICTION INTERVALS

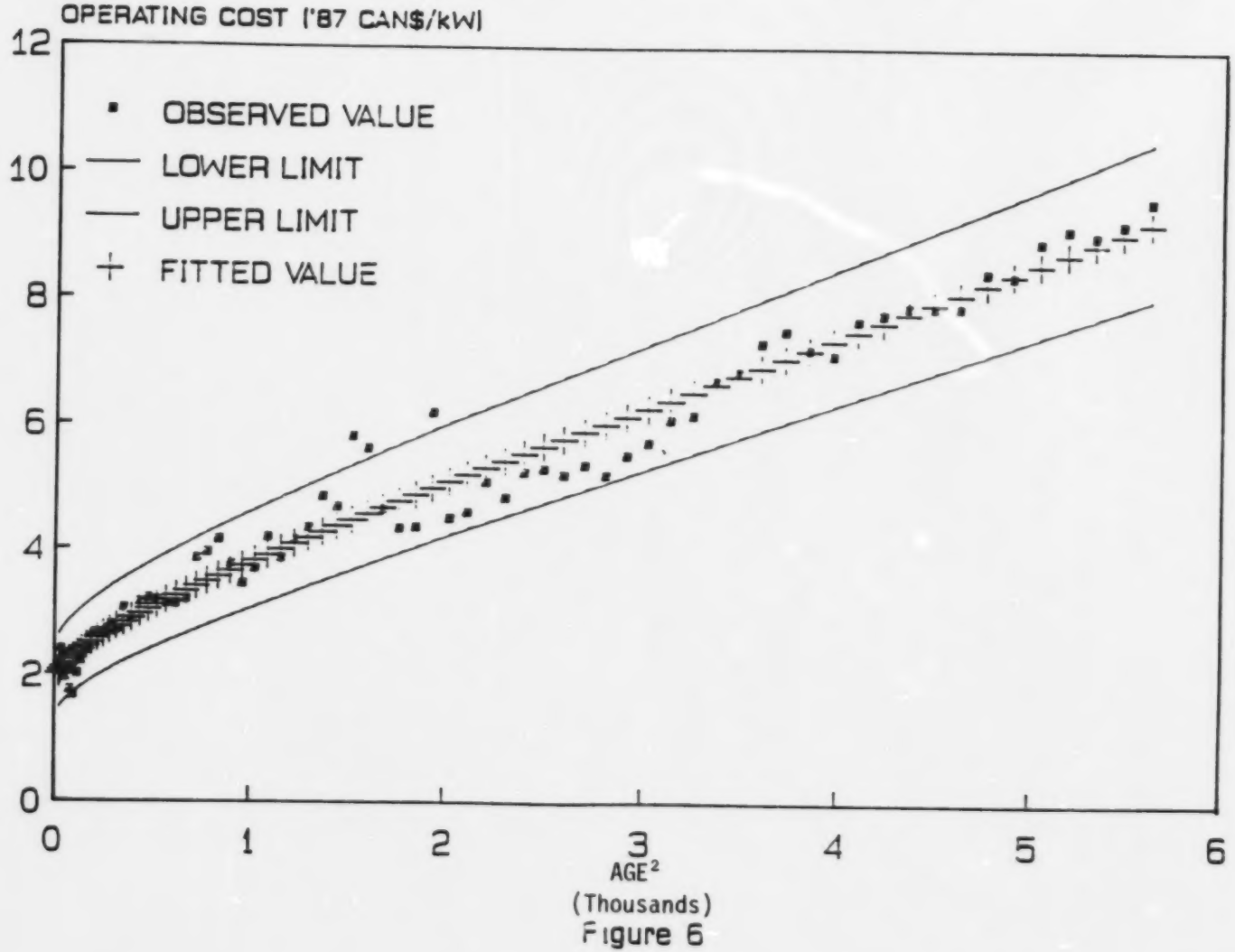

Figure 6

US HYDRAULIC UTILITIES
MAINTENANCE AND OPERATING COST

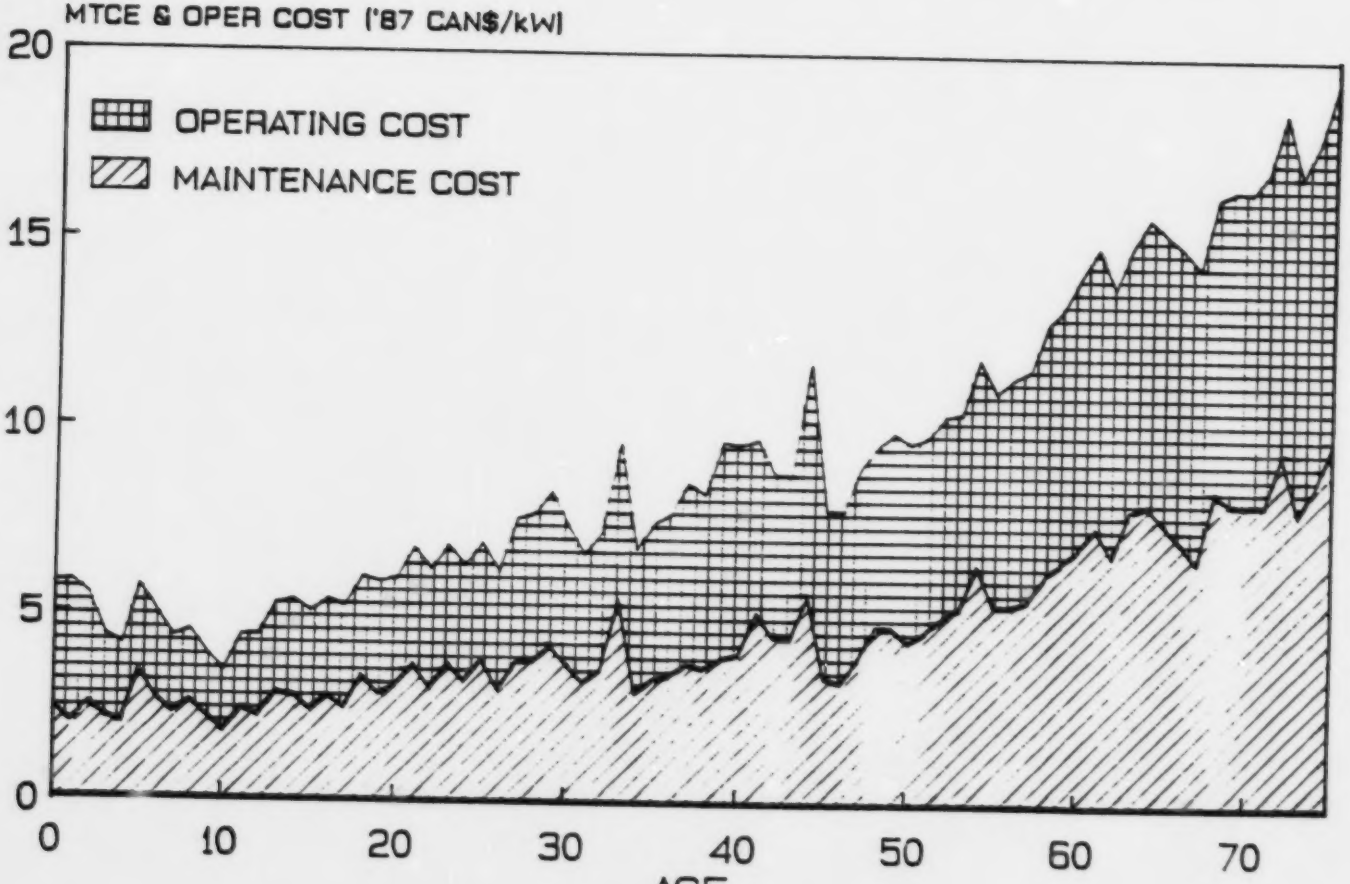

Figure 7

US HYDRAULIC UTILITIES
MAINTENANCE & OPERATING COST vs AGE

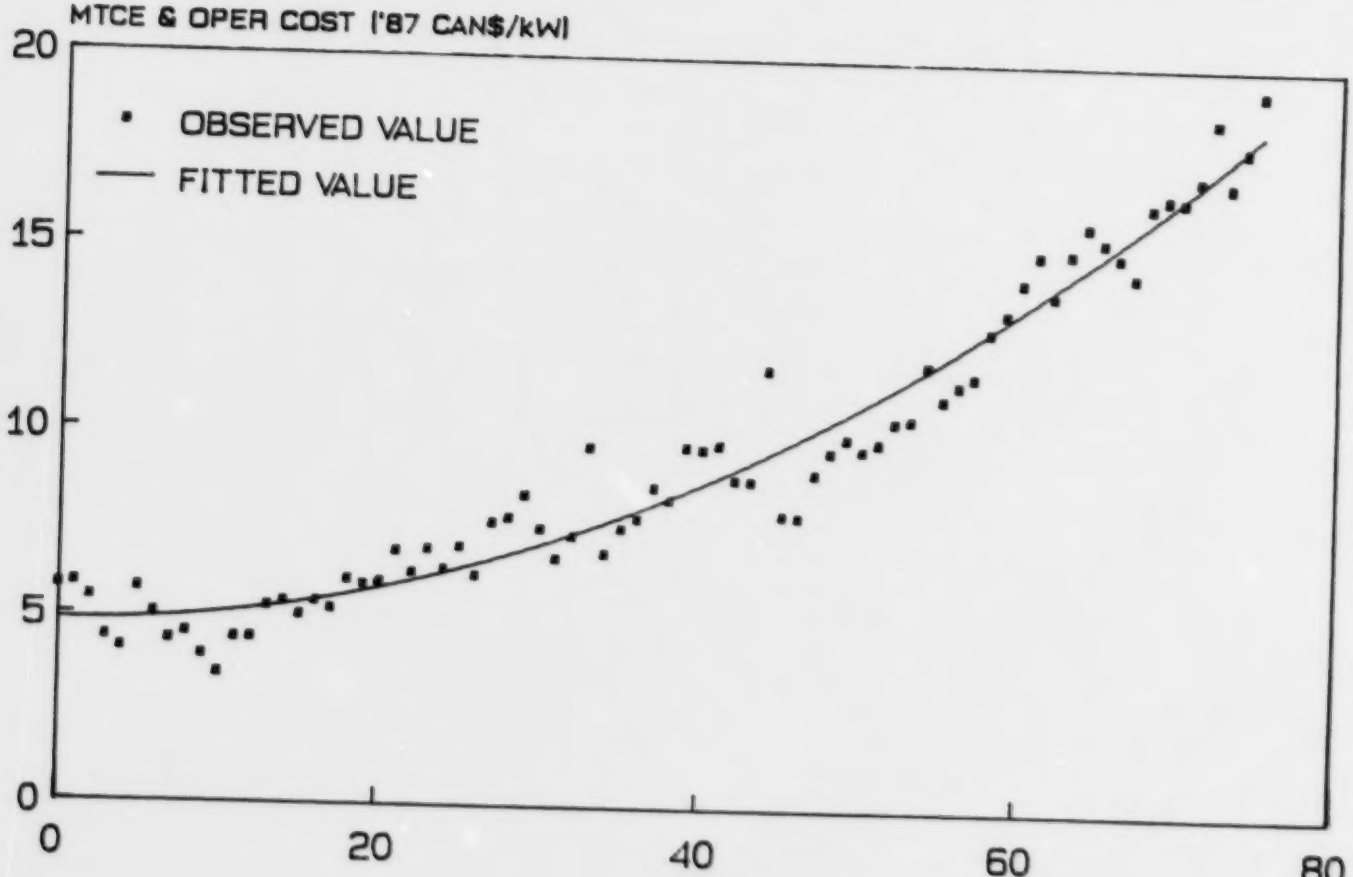

Figure 8

95% PREDICTION INTERVALS

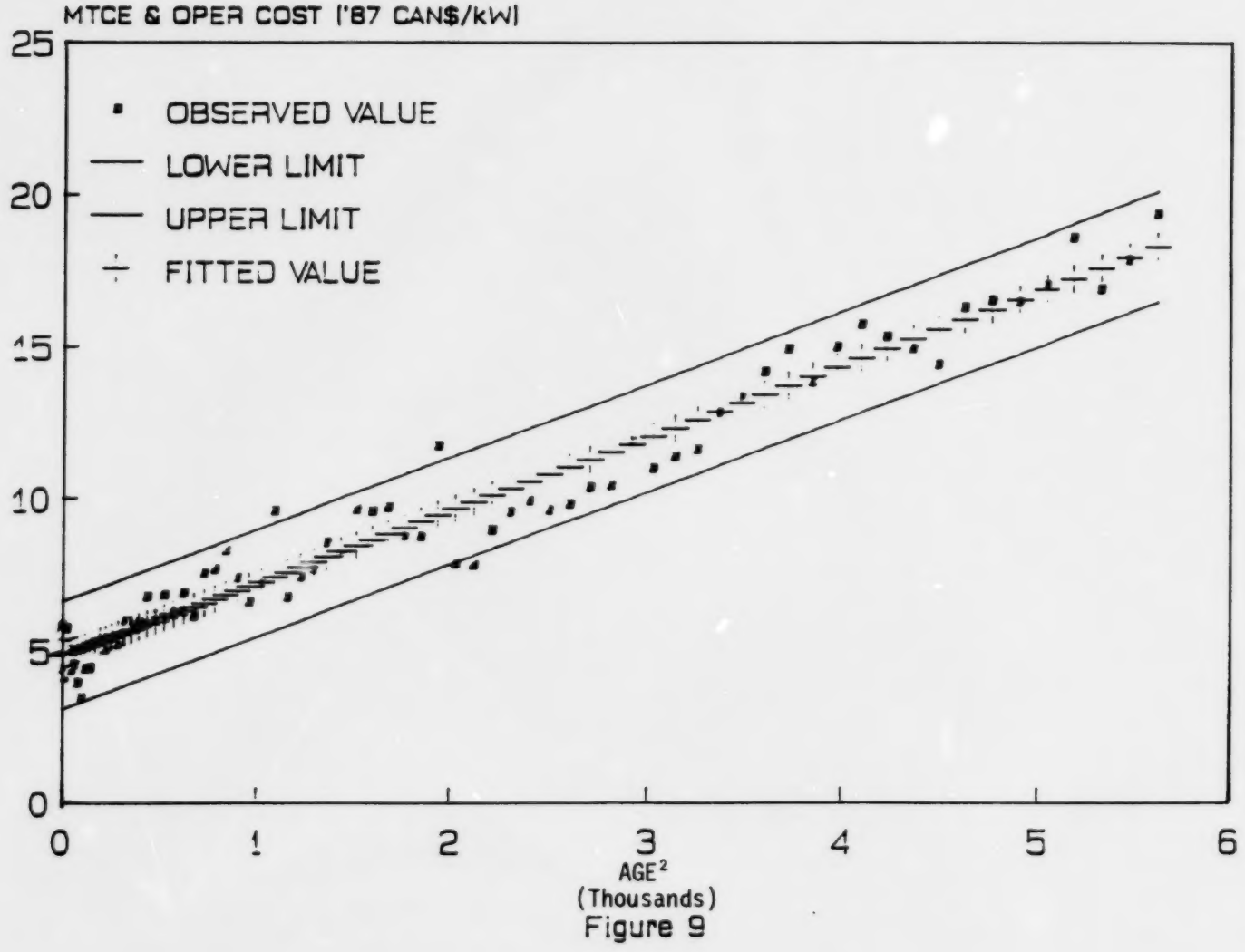

Figure 9

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US HYDRAULIC UTILITIES
CAPITAL MODIFICATIONS

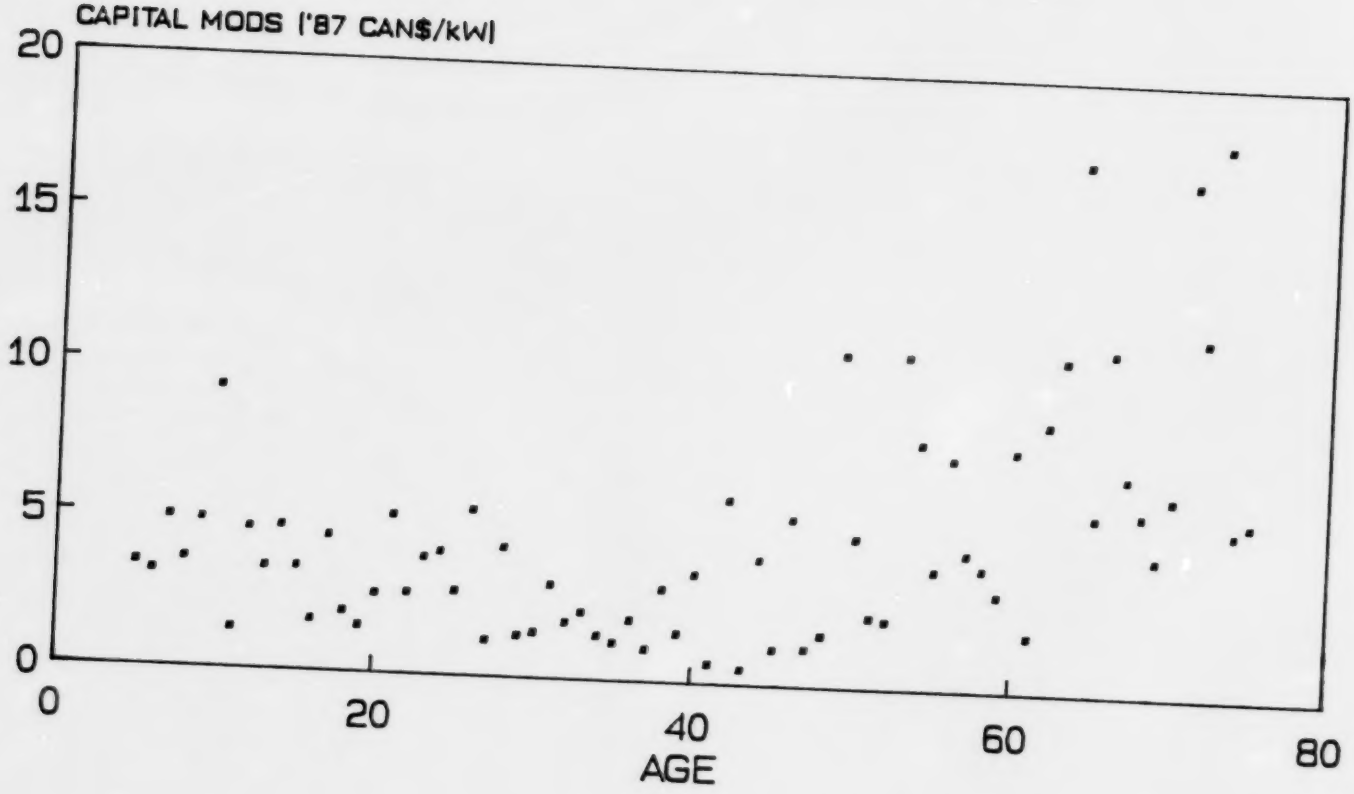


Figure 10

US HYDRAULIC UTILITIES
CAPITAL MODIFICATIONS VS AGE

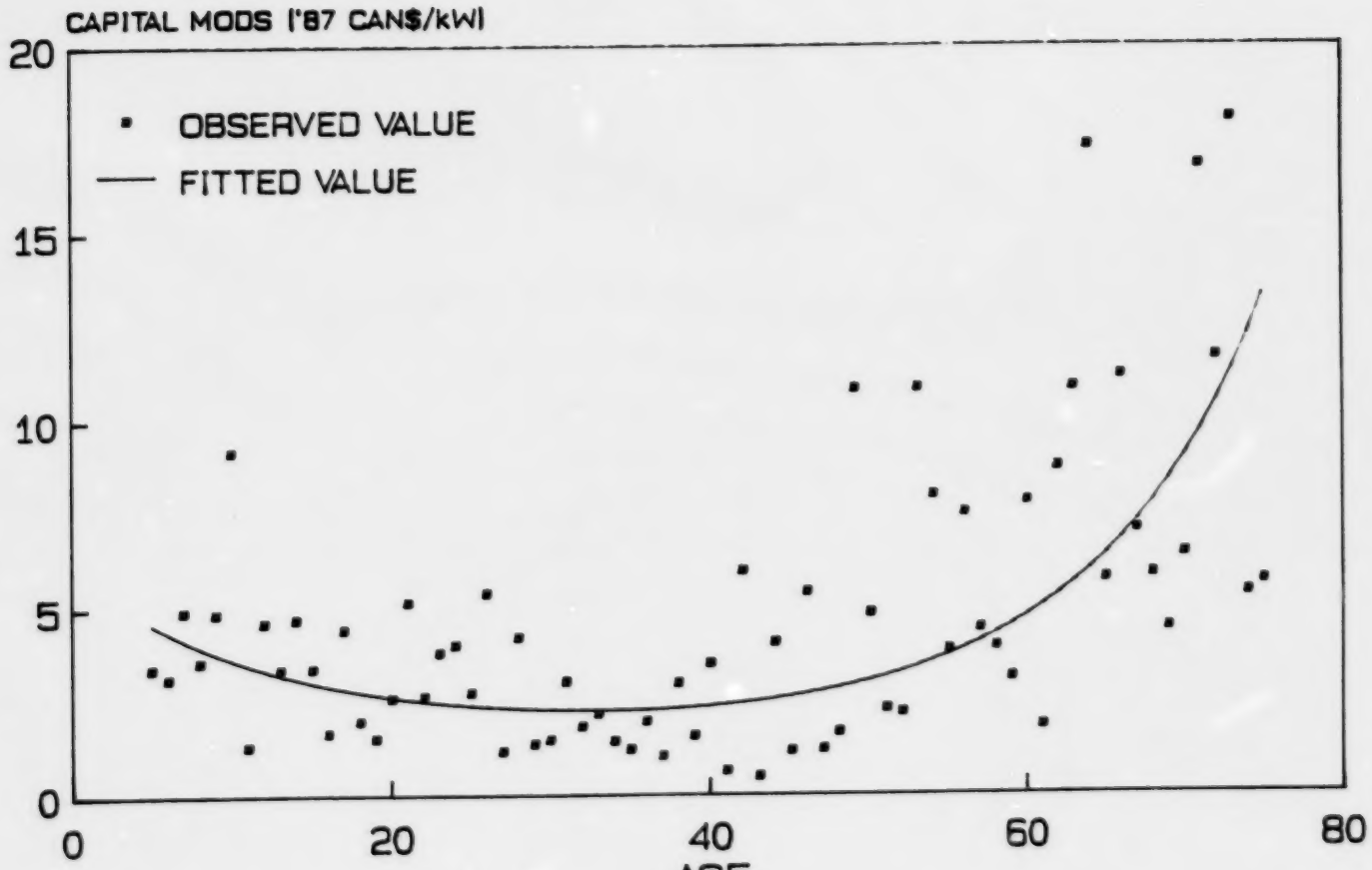


Figure 11

95% PREDICTION INTERVALS

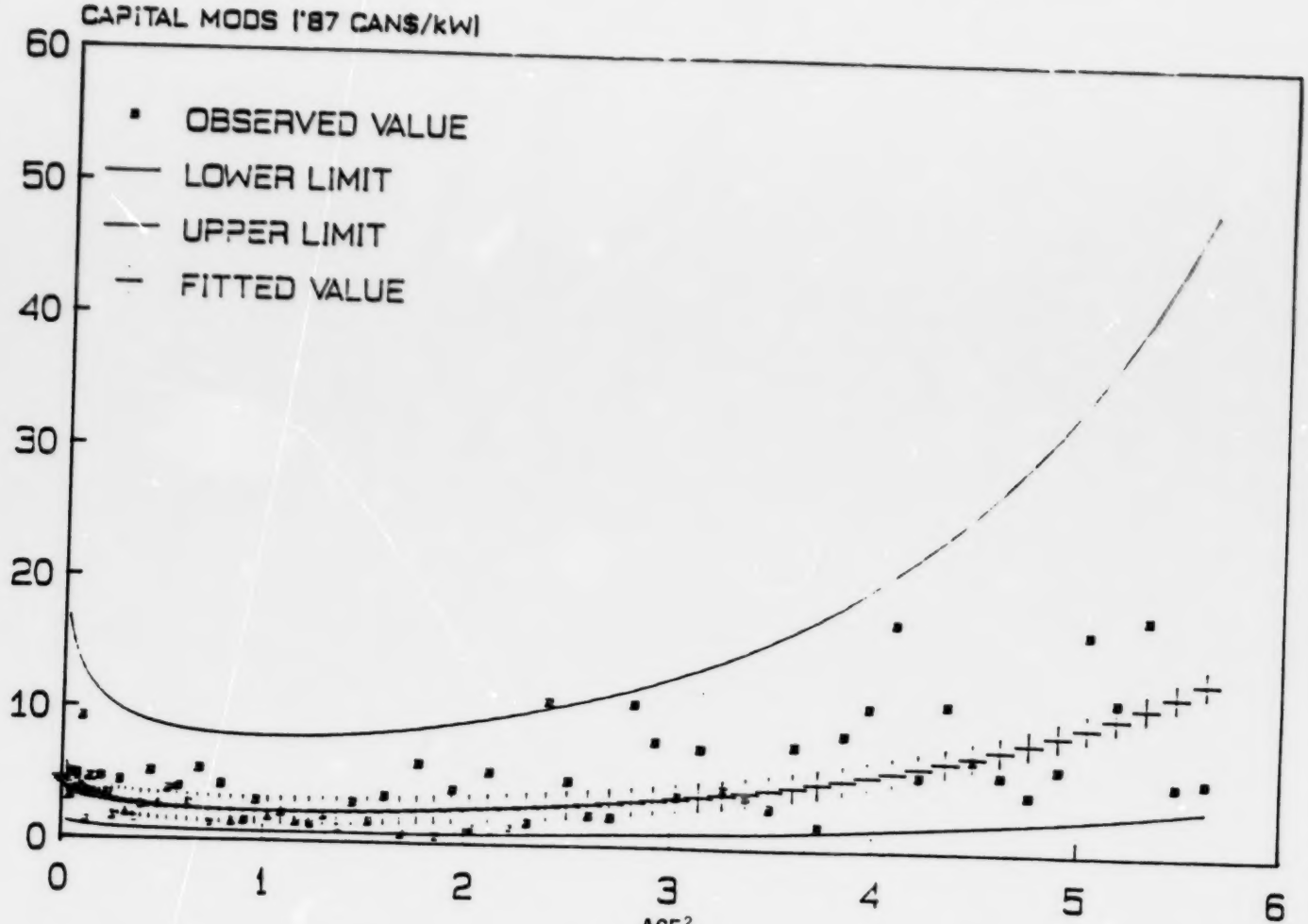


Figure 12

US HYDRAULIC UTILITIES
TOTAL COST

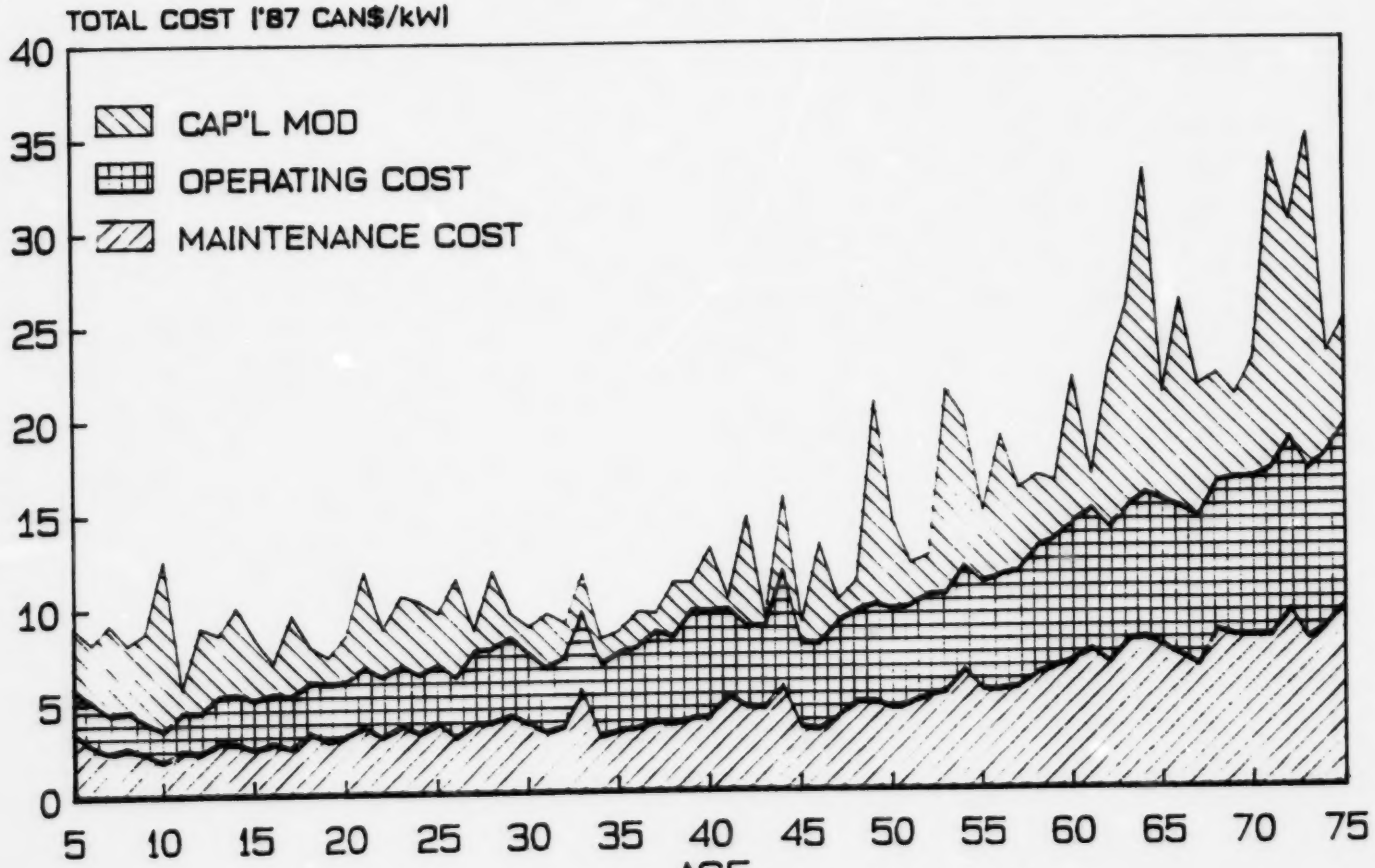


Figure 13

US HYDRAULIC UTILITIES
TOTAL COST VS AGE

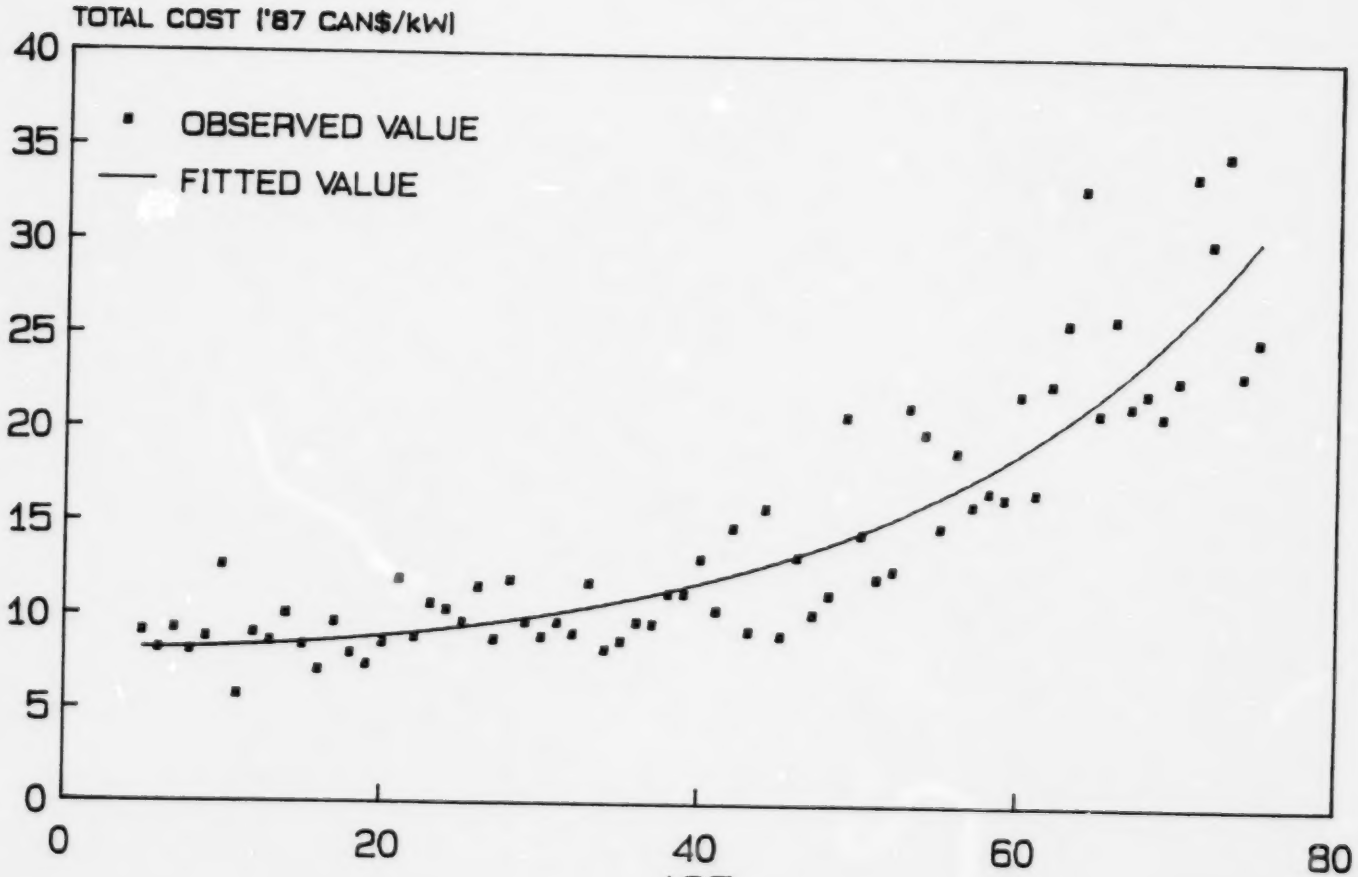


Figure 14

95% PREDICTION INTERVALS

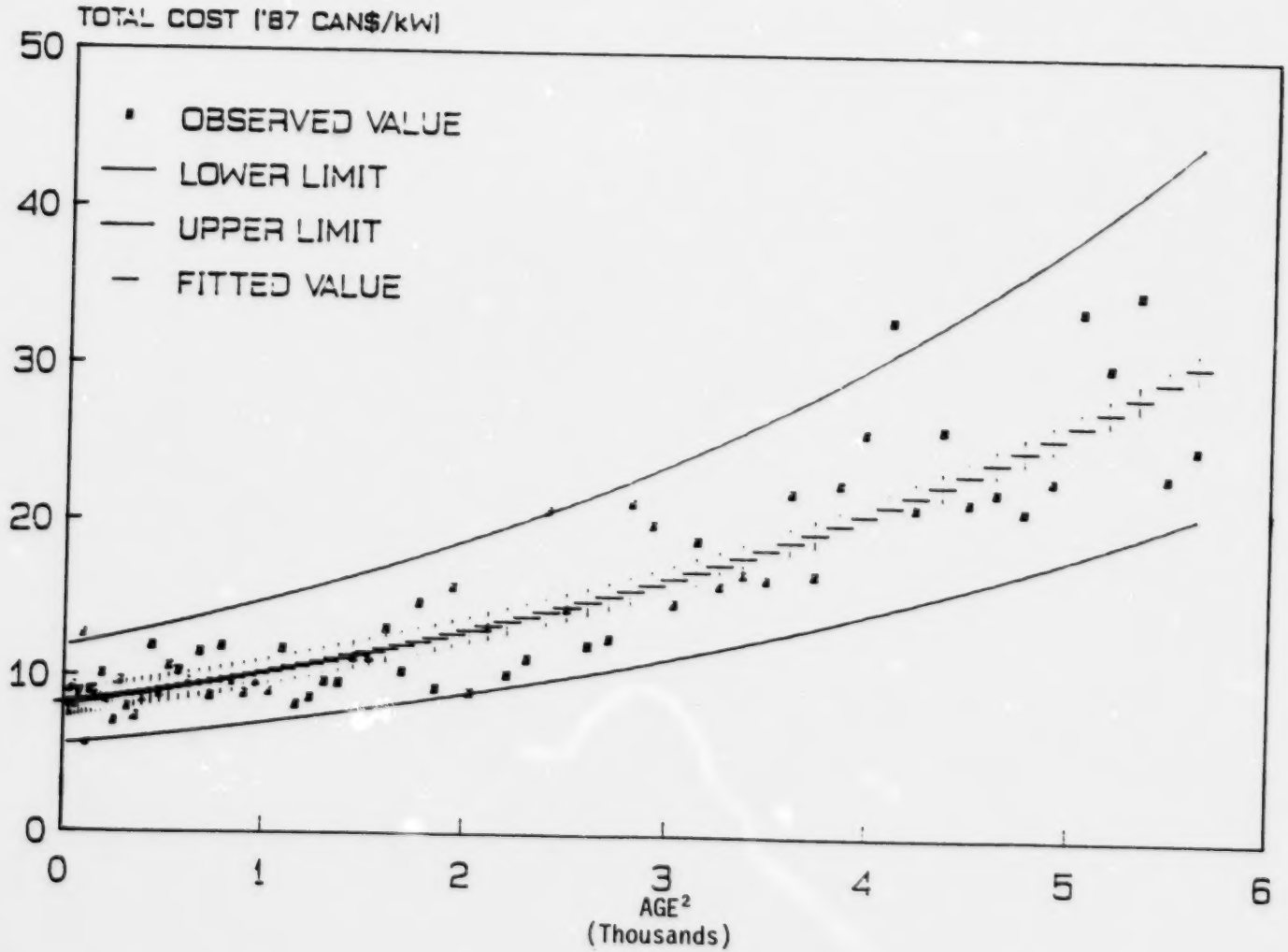


Figure 15

TABLE 1

Model: MODEL 1
Dependent Variable: MTCE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	269.01437	269.01437	385.059	0.0001
Error	74	51.69880	0.69863		
C Total	75	320.71317			

Root MSE	0.83584	R-square	0.8388
Dep Mean	4.53368	Adj R-sq	0.8366
C.V.	18.43627		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	1.317604	0.18987845	6.939	0.0001
AGE	1	0.085762	0.00437051	19.623	0.0001

TABLE 2

Model: MODEL 1
Dependent Variable: MTCE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	293.54784	146.77392	394.418	0.0001
Error	73	27.16533	0.37213		
C Total	75	320.71317			

Root MSE	0.61002	R-square	0.9153
Dep Mean	4.53368	Adj R-sq	0.9130
C.V.	13.45534		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	2.538874	0.20451759	12.414	0.0001
AGE	1	-0.013260	0.01260568	-1.052	0.2963
AGE2	1	0.001320	0.00016261	8.120	0.0001

TABLE 3

Model: MODEL 1
Dependent Variable: MTCE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	293.13609	293.13609	786.598	0.0001
Error	74	27.57707	0.37266		
C Total	75	320.71317			

Root MSE	0.61046	R-square	0.9140
Dep Mean	4.53368	Adj R-sq	0.9129
C.V.	13.46502		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	2.353971	0.10461161	22.502	0.0001
AGE2	1	0.001155	0.00004118	28.046	0.0001

Table 4

Results Based on Regression of MTCE with AGE2

OBS	AGE	MTCE ($/kW)	AGE2	FITTED	LOWER	UPPER	RESIDUAL
1	0	2.39	0	2.35397	1.11987	3.58808	0.03603
2	1	1.97	1	2.35513	1.12103	3.58922	-0.38513
3	2	2.50	4	2.35859	1.12453	3.59265	0.14141
4	3	2.15	9	2.36436	1.13035	3.59838	-0.21436
5	4	1.99	16	2.37245	1.13851	3.60639	-0.38245
6	5	3.39	25	2.38284	1.14899	3.61669	1.00716
7	6	2.65	36	2.39554	1.16181	3.62928	0.25446
8	7	2.26	49	2.41056	1.17695	3.64416	-0.15056
9	8	2.59	64	2.42788	1.19442	3.66134	0.16212
10	9	2.19	81	2.44751	1.21422	3.68080	-0.25751
11	10	1.78	100	2.46945	1.23635	3.70255	-0.68945
12	11	2.40	121	2.49370	1.26080	3.72660	-0.09370
13	12	2.21	144	2.52026	1.28759	3.75294	-0.31026
14	13	2.84	169	2.54913	1.31669	3.78158	0.29087
15	14	2.76	196	2.58031	1.34812	3.81250	0.17969
16	15	2.38	225	2.61380	1.38188	3.84573	-0.23380
17	16	2.77	256	2.64960	1.41796	3.88125	0.12040
18	17	2.43	289	2.68771	1.45636	3.91907	-0.25771
19	18	3.29	324	2.72813	1.49708	3.95918	0.56187
20	19	2.80	361	2.77086	1.54012	4.00160	0.02914
21	20	3.07	400	2.81590	1.58548	4.04631	0.25410
22	21	3.62	441	2.86324	1.63316	4.09333	0.75676
23	22	2.98	484	2.91290	1.68315	4.14265	0.06710
24	23	3.65	529	2.96487	1.73545	4.19428	0.68513
25	24	3.17	576	3.01914	1.79007	4.24821	0.15086
26	25	3.78	625	3.07573	1.84701	4.30445	0.70427
27	26	2.94	676	3.13463	1.90625	4.36300	-0.19463
28	27	3.70	729	3.19583	1.96780	4.42387	0.50417
29	28	3.74	784	3.25935	2.03165	4.48704	0.48065
30	29	4.14	841	3.32517	2.09781	4.55253	0.81483
31	30	3.64	900	3.39330	2.16628	4.62033	0.24670
32	31	3.16	961	3.46375	2.23704	4.69046	-0.30375
33	32	3.53	1024	3.53650	2.31010	4.76290	-0.00650
34	33	5.40	1089	3.61156	2.38546	4.83767	1.78844
35	34	2.91	1156	3.68894	2.46312	4.91476	-0.77894
36	35	3.28	1225	3.76862	2.54306	4.99418	-0.48862
37	36	3.37	1296	3.85061	2.62530	5.07592	-0.48061
38	37	3.71	1369	3.93491	2.70982	5.16000	-0.22491
39	38	3.56	1444	4.02152	2.79663	5.24641	-0.46152
40	39	3.85	1521	4.11044	2.88572	5.33516	-0.26044
41	40	3.97	1600	4.20167	2.97710	5.42625	-0.23167

TABLE 4 (Cont'd)

Results Based on Regression of
MTCE with AGE2

OBS	AGE	MTCE ($/kW)	AGE2	FITTED	LOWER	UPPER	RESIDUAL
42	41	5.07	1681	4.29521	3.07075	5.51968	0.77479
43	42	4.45	1764	4.39106	3.16667	5.61546	0.05894
44	43	4.40	1849	4.48922	3.26487	5.71358	-0.08922
45	44	5.56	1936	4.58969	3.36534	5.81405	0.97031
46	45	3.36	2025	4.69247	3.46807	5.91687	-1.33247
47	46	3.22	2116	4.79756	3.57307	6.02205	-1.57756
48	47	3.89	2209	4.90496	3.68032	6.12959	-1.01496
49	48	4.72	2304	5.01466	3.78984	6.23949	-0.29466
50	49	4.69	2401	5.12668	3.90161	6.35176	-0.43668
51	50	4.32	2500	5.24101	4.01563	6.46639	-0.92101
52	51	4.62	2601	5.35764	4.13190	6.58339	-0.73764
53	52	5.02	2704	5.47659	4.25041	6.70277	-0.45659
54	53	5.25	2809	5.59785	4.37116	6.82453	-0.34785
55	54	6.38	2916	5.72141	4.49416	6.94867	0.65859
56	55	5.29	3025	5.84729	4.61938	7.07519	-0.55729
57	56	5.30	3136	5.97547	4.74684	7.20410	-0.67547
58	57	5.46	3249	6.10597	4.87653	7.33540	-0.64597
59	58	6.13	3364	6.23877	5.00844	7.46910	-0.10877
60	59	6.48	3481	6.37388	5.14257	7.60519	0.10612
61	60	6.86	3600	6.51131	5.27892	7.74369	0.34869
62	61	7.42	3721	6.65104	5.41748	7.88459	0.76896
63	62	6.63	3844	6.79308	5.55825	8.02791	-0.16308
64	63	7.86	3969	6.93743	5.70123	8.17364	0.92257
65	64	8.05	4096	7.08409	5.84641	8.32178	0.96591
66	65	7.54	4225	7.23306	5.99379	8.47234	0.30694
67	66	7.03	4356	7.38435	6.14336	8.62533	-0.35435
68	67	6.50	4489	7.53794	6.29512	8.78075	-1.03794
69	68	8.38	4624	7.69384	6.44907	8.9386	0.68616
70	69	8.06	4761	7.85205	6.60520	9.0989	0.20795
71	70	8.06	4900	8.01256	6.76352	9.2616	0.04744
72	71	8.08	5041	8.17539	6.92401	9.4268	-0.09539
73	72	9.42	5184	8.34053	7.08667	9.5944	1.07947
74	73	7.83	5329	8.50798	7.25149	9.7645	-0.67798
75	74	8.59	5476	8.67774	7.41849	9.9370	-0.08774
76	75	9.73	5625	8.84981	7.58764	10.1120	0.88019

TABLE 5

Model: MODEL 1
Dependent Variable: OPER

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	317.19788	158.59894	882.561	0.0001
Error	68	12.21981	0.17970		
C Total	70	329.41769			

Root MSE	0.42391	R-square	0.9629
Dep Mean	4.93761	Adj R-sq	0.9618
C.V.	8.58542		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	1.949155	0.19277196	10.111	0.0001
AGE	1	0.028410	0.01099457	2.584	0.0119
AGE2	1	0.000917	0.00013396	6.844	0.0001

TABLE 6

Model: MODEL 1
Dependent Variable: SOPER

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	16.10326	8.05163	851.875	0.0001
Error	68	0.64271	0.00945		
C Total	70	16.74598			

Root MSE	0.09722	R-square	0.9616
Dep Mean	2.16835	Adj R-sq	0.9605
C.V.	4.48357		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	1.327793	0.04420996	30.034	0.0001
AGE	1	0.017274	0.00252147	6.851	0.0001
AGE2	1	0.000074055	0.00003072	2.410	0.0186

TABLE 7

Results Based on Regression
of SOPER with AGE and AGE2

OBS	AGE	OPER ($/kW)	AGE2	SOPER	FITTED	LOWER	UPPER	RESIDUAL
1	5	2.32	25	1.52315	1.41602	1.21072	1.62131	0.10714
2	6	2.39	36	1.54596	1.43410	1.22999	1.63821	0.11186
3	7	2.08	49	1.44222	1.45234	1.24931	1.65537	-0.01012
4	8	1.95	64	1.39642	1.47073	1.26866	1.67279	-0.07430
5	9	1.75	81	1.32288	1.48926	1.28807	1.69045	-0.16638
6	10	1.67	100	1.29228	1.50794	1.30752	1.70836	-0.21566
7	11	2.01	121	1.41774	1.52677	1.32704	1.72650	-0.10903
8	12	2.21	144	1.48661	1.54575	1.34662	1.74488	-0.05914
9	13	2.42	169	1.55563	1.56487	1.36627	1.76348	-0.00924
10	14	2.63	196	1.62173	1.58415	1.38599	1.78230	0.03758
11	15	2.66	225	1.63095	1.60357	1.40580	1.80134	0.02738
12	16	2.64	256	1.62481	1.62314	1.42569	1.82058	0.00167
13	17	2.79	289	1.67033	1.64286	1.44568	1.84003	0.02747
14	18	2.71	324	1.64621	1.66272	1.46577	1.85968	-0.01651
15	19	3.06	361	1.74929	1.68274	1.48595	1.87952	0.06655
16	20	2.88	400	1.69706	1.70290	1.50625	1.89955	-0.00584
17	21	3.16	441	1.77764	1.72321	1.52665	1.91977	0.05443
18	22	3.22	484	1.79444	1.74367	1.54718	1.94016	0.05077
19	23	3.19	529	1.78606	1.76427	1.56782	1.96073	0.02178
20	24	3.13	576	1.76918	1.78503	1.58859	1.98147	-0.01585
21	25	3.13	625	1.76918	1.80593	1.60948	2.00238	-0.03675
22	26	3.21	676	1.79165	1.82698	1.63051	2.02346	-0.03534
23	27	3.86	729	1.96469	1.84818	1.65167	2.04469	0.11651
24	28	3.96	784	1.98997	1.86953	1.67297	2.06608	0.12045
25	29	4.16	841	2.03961	1.89102	1.69442	2.08763	0.14858
26	30	3.77	900	1.94165	1.91267	1.71600	2.10933	0.02898
27	31	3.46	961	1.86011	1.93446	1.73774	2.13118	-0.07435
28	32	3.70	1024	1.92354	1.95640	1.75962	2.15318	-0.03286
29	33	4.20	1089	2.04939	1.97849	1.78165	2.17532	0.07090
30	34	3.87	1156	1.96723	2.00072	1.80383	2.19761	-0.03349
31	35	4.17	1225	2.04206	2.02311	1.82617	2.22004	0.01895
32	36	4.35	1296	2.08567	2.04564	1.84866	2.24261	0.04003
33	37	4.85	1369	2.20227	2.06832	1.87131	2.26533	0.13395
34	38	4.68	1444	2.16333	2.09115	1.89412	2.28818	0.07218
35	39	5.80	1521	2.40832	2.11412	1.91708	2.31117	0.29420
36	40	5.61	1600	2.36854	2.13725	1.94020	2.33430	0.23130
37	41	4.65	1681	2.15639	2.16052	1.96348	2.35757	-0.00413
38	42	4.34	1764	2.08327	2.18394	1.98691	2.38097	-0.10067
39	43	4.36	1849	2.08806	2.20751	2.01050	2.40452	-0.11945
40	44	6.18	1936	2.48596	2.23123	2.03425	2.42820	0.25473
41	45	4.50	2025	2.12132	2.25509	2.05816	2.45203	-0.13377
42	46	4.60	2116	2.14476	2.27911	2.08222	2.47599	-0.13434
43	47	5.08	2209	2.25389	2.30327	2.10643	2.50010	-0.04938
44	48	4.84	2304	2.20000	2.32758	2.13079	2.52436	-0.12758

TABLE 7 (Cont'd)

Results Based on Regression
of SOPER with AGE and AGE2

OBS	AGE	OPER	AGE2	SOPER	FITTED	LOWER	UPPER	RESIDUAL
45	49	5.24	2401	2.28910	2.35203	2.15531	2.54876	-0.06293
46	50	5.30	2500	2.30217	2.37664	2.17998	2.57330	-0.07447
47	51	5.20	2601	2.28035	2.40139	2.20479	2.59800	-0.12104
48	52	5.36	2704	2.31517	2.42629	2.22974	2.62285	-0.11113
49	53	5.20	2809	2.28035	2.45134	2.25484	2.64785	-0.17099
50	54	5.52	2916	2.34947	2.47654	2.28007	2.67302	-0.12707
51	55	5.72	3025	2.39165	2.50189	2.30544	2.69834	-0.11024
52	56	6.09	3136	2.46779	2.52738	2.33094	2.72383	-0.059591
53	57	6.16	3249	2.48193	2.55303	2.35657	2.74948	-0.071091
54	58	6.71	3364	2.59037	2.57882	2.38232	2.77531	0.011551
55	59	6.85	3481	2.61725	2.60475	2.40820	2.80131	0.012496
56	60	7.31	3600	2.70370	2.63084	2.43419	2.82749	0.072860
57	61	7.50	3721	2.73861	2.65708	2.46029	2.85386	0.081536
58	62	7.21	3844	2.68514	2.68346	2.48650	2.88042	0.001685
59	63	7.12	3969	2.66833	2.70999	2.51282	2.90717	-0.041658
60	64	7.67	4096	2.76948	2.73667	2.53923	2.93411	0.032807
61	65	7.77	4225	2.78747	2.76350	2.56573	2.96127	0.023975
62	66	7.89	4356	2.80891	2.79047	2.59232	2.98863	0.018442
63	67	7.89	4489	2.80891	2.81760	2.61899	3.01620	-0.008681
64	68	7.89	4624	2.80891	2.84487	2.64574	3.04400	-0.035953
65	69	8.44	4761	2.90517	2.87229	2.67255	3.07202	0.032881
66	70	8.39	4900	2.89655	2.89986	2.69944	3.10027	-0.003305
67	71	8.93	5041	2.98831	2.92757	2.72638	3.12876	0.060740
68	72	9.14	5184	3.02324	2.95544	2.75337	3.15750	0.067808
69	73	9.04	5329	3.00666	2.98345	2.78041	3.18648	0.023212
70	74	9.23	5476	3.03809	3.01161	2.80750	3.21572	0.026484
71	75	9.60	5625	3.09839	3.03992	2.83462	3.24521	0.058471

TABLE 8

Model: MODEL 1
Dependent Variable: MNOP

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	1253.17355	626.58677	807.283	0.0001
Error	73	56.66019	0.77617		
C Total	75	1309.83374			

Root MSE	0.88100	R-square	0.9567
Dep Mean	9.33816	Adj R-sq	0.9556
C.V.	9.43445		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	4.968325	0.29536717	16.821	0.0001
AGE	1	-0.009795	0.01820530	-0.538	0.5922
AGE2	1	0.002510	0.00023484	10.687	0.0001

TABLE 9

Model: MODEL 1
Dependent Variable: MNOP

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	1252.94888	1252.94888	1629.928	0.0001
Error	74	56.88486	0.76871		
C Total	75	1309.83374			

Root MSE	0.87676	R-square	0.9566
Dep Mean	9.33816	Adj R-sq	0.9560
C.V.	9.38904		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	4.831740	0.15024643	32.159	0.0001
AGE2	1	0.002388	0.00005914	40.372	0.0001

TABLE 10

Results Based on Regression of
MNOP with AGE2

OBS	AGE	MNOP ($/kW)	AGE2	FITTED	LOWER	UPPER	RESIDUAL
1	0	5.76	0	4.83174	3.05928	6.60420	0.92826
2	1	5.83	1	4.83413	3.06168	6.60657	0.99587
3	2	5.46	4	4.84129	3.06889	6.61369	0.61871
4	3	4.40	9	4.85323	3.08090	6.62555	-0.45323
5	4	4.12	16	4.86994	3.09772	6.64216	-0.74994
6	5	5.71	25	4.89143	3.11934	6.66352	0.81857
7	6	5.04	36	4.91769	3.14576	6.68962	0.12231
8	7	4.34	49	4.94873	3.17698	6.72047	-0.60873
9	8	4.54	64	4.98454	3.21301	6.75607	-0.44454
10	9	3.94	81	5.02513	3.25384	6.79642	-1.08513
11	10	3.45	100	5.07049	3.29947	6.84151	-1.62049
12	11	4.41	121	5.12063	3.34990	6.89136	-0.71063
13	12	4.42	144	5.17554	3.40513	6.94595	-0.75554
14	13	5.26	169	5.23523	3.46516	7.00530	0.02477
15	14	5.39	196	5.29969	3.52998	7.06940	0.09031
16	15	5.04	225	5.36893	3.59960	7.13826	-0.32893
17	16	5.41	256	5.44294	3.67401	7.21187	-0.03294
18	17	5.22	289	5.52173	3.75322	7.29024	-0.30173
19	18	6.00	324	5.60529	3.83722	7.37337	0.39471
20	19	5.86	361	5.69363	3.92600	7.46126	0.16637
21	20	5.95	400	5.78674	4.01958	7.55391	0.16326
22	21	6.78	441	5.88463	4.11794	7.65132	0.89537
23	22	6.20	484	5.98729	4.22108	7.75350	0.21271
24	23	6.84	529	6.09473	4.32901	7.86045	0.74527
25	24	6.30	576	6.20694	4.44172	7.97217	0.09306
26	25	6.91	625	6.32393	4.55920	8.08866	0.58607
27	26	6.15	676	6.44569	4.68146	8.20993	-0.29569
28	27	7.56	729	6.57223	4.80849	8.33597	0.98777
29	28	7.70	784	6.70354	4.94029	8.46680	0.99646
30	29	8.30	841	6.83963	5.07686	8.60240	1.46037
31	30	7.41	900	6.98050	5.21820	8.74279	0.42950
32	31	6.62	961	7.12613	5.36430	8.88797	-0.50613
33	32	7.23	1024	7.27655	5.51515	9.03794	-0.04655
34	33	9.60	1089	7.43173	5.67077	9.19270	2.16827
35	34	6.78	1156	7.5917	5.83114	9.3523	-0.81170
36	35	7.45	1225	7.7564	5.99625	9.5166	-0.30644
37	36	7.72	1296	7.9259	6.16612	9.6858	-0.20595
38	37	8.56	1369	8.1002	6.34072	9.8597	0.45976
39	38	8.24	1444	8.2793	6.52007	10.0385	-0.03930
40	39	9.65	1521	8.4631	6.70416	10.2221	1.18686
41	40	9.58	1600	8.6517	6.89297	10.4105	0.92825
42	41	9.72	1681	8.8451	7.08652	10.6038	0.87486
43	42	8.79	1764	9.0433	7.28479	10.8018	-0.25330
44	43	8.76	1849	9.2462	7.48778	11.0047	-0.48624

Table 10 (Cont'd)

Results Based on Regression of
MNOP with AGE2

OBS	AGE	MNOP ($/kW)	AGE2	FITTED	LOWER	UPPER	RESIDUAL
45	44	11.74	1936	9.4540	7.69549	11.2124	2.28605
46	45	7.86	2025	9.6664	7.90792	11.4250	-1.80644
47	46	7.82	2116	9.8837	8.12505	11.6424	-2.06370
48	47	8.97	2209	10.1057	8.34688	11.8646	-1.13574
49	48	9.56	2304	10.3326	8.57342	12.0917	-0.77255
50	49	9.93	2401	10.5641	8.80465	12.3236	-0.63414
51	50	9.62	2500	10.8005	9.04057	12.5604	-1.18051
52	51	9.82	2601	11.0416	9.2812	12.8021	-1.22164
53	52	10.38	2704	11.2876	9.5265	13.0486	-0.90756
54	53	10.45	2809	11.5382	9.7764	13.3000	-1.08824
55	54	11.90	2916	11.7937	10.0311	13.5563	0.10629
56	55	11.01	3025	12.0539	10.2904	13.8175	-1.04395
57	56	11.39	3136	12.3190	10.5544	14.0836	-0.92896
58	57	11.62	3249	12.5887	10.8230	14.3545	-0.96875
59	58	12.84	3364	12.8633	11.0963	14.6303	-0.02331
60	59	13.33	3481	13.1426	11.3742	14.9111	0.18735
61	60	14.17	3600	13.4268	11.6568	15.1968	0.74324
62	61	14.92	3721	13.7157	11.9440	15.4873	1.20435
63	62	13.84	3844	14.0093	12.2358	15.7828	-0.16931
64	63	14.98	3969	14.3078	12.5323	16.0832	0.67225
65	64	15.72	4096	14.6110	12.8334	16.3886	1.10903
66	65	15.31	4225	14.9190	13.1391	16.6988	0.39105
67	66	14.92	4356	15.2317	13.4494	17.0141	-0.31172
68	67	14.39	4489	15.5493	13.7643	17.3342	-1.15926
69	68	16.27	4624	15.8716	14.0838	17.6593	0.39843
70	69	16.50	4761	16.1987	14.4079	17.9894	0.30134
71	70	16.45	4900	16.5305	14.7366	18.3244	-0.08052
72	71	17.01	5041	16.8672	15.0699	18.6644	0.14284
73	72	18.56	5184	17.2086	15.4077	19.0094	1.35143
74	73	16.87	5329	17.5548	15.7502	19.3594	-0.68476
75	74	17.82	5476	17.9057	16.0971	19.7143	-0.08572
76	75	19.33	5625	18.2615	16.4487	20.0742	1.06854

TABLE 11

Model: MODEL 1
Dependent Variable: LCAPL

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	16.17273	8.08637	21.134	0.0001
Error	68	26.01794	0.38262		
C Total	70	42.19068			

Root MSE	0.61856	R-square	0.3833
Dep Mean	1.27923	Adj R-sq	0.3652
C.V.	48.35424		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	1.805956	0.28128600	6.420	0.0001
AGE	1	-0.061756	0.01604288	-3.849	0.0003
AGE2	1	0.000962	0.00019547	4.922	0.0001

TABLE 12

Results Based on Regression of
LCAPL with AGE and AGE2

OBS	AGE	CAPL ($/kW)	AGE2	LCAPL	FITTED	LOWER	UPPER	RESIDUAL
1	5	3.40	25	1.22378	1.52123	0.21502	2.82744	-0.29745
2	6	3.14	36	1.14422	1.47006	0.17141	2.76870	-0.32583
3	7	4.92	49	1.59331	1.42081	0.12901	2.71260	0.17250
4	8	3.57	64	1.27257	1.37348	0.08786	2.65911	-0.10092
5	9	4.86	81	1.58104	1.32808	0.04799	2.60817	0.25296
6	10	9.19	100	2.21812	1.28461	0.00944	2.55977	0.93351
7	11	1.32	121	0.27763	1.24306	-0.02775	2.51386	-0.96542
8	12	4.61	144	1.52823	1.20343	-0.06354	2.47040	0.32480
9	13	3.36	169	1.21194	1.16573	-0.09791	2.42936	0.04621
10	14	4.70	196	1.54756	1.12995	-0.13081	2.39071	0.41761
11	15	3.39	225	1.22083	1.09609	-0.16221	2.35440	0.12474
12	16	1.67	256	0.51282	1.06416	-0.19207	2.32040	-0.55134
13	17	4.42	289	1.48614	1.03416	-0.22037	2.28869	0.45198
14	18	1.98	324	0.68310	1.00608	-0.24706	2.25922	-0.32298
15	19	1.52	361	0.41871	0.97992	-0.27212	2.23196	-0.56121
16	20	2.59	400	0.95166	0.95569	-0.29551	2.20689	-0.00403
17	21	5.15	441	1.63900	0.93338	-0.31721	2.18397	0.70562
18	22	2.64	484	0.97078	0.91299	-0.33719	2.16318	0.05778
19	23	3.80	529	1.33500	0.89453	-0.35542	2.14449	0.44047
20	24	4.01	576	1.38879	0.87800	-0.37187	2.12787	0.51079
21	25	2.74	625	1.00796	0.86339	-0.38653	2.11330	0.14457
22	26	5.39	676	1.68455	0.85070	-0.39936	2.10076	0.83385
23	27	1.18	729	0.16551	0.83994	-0.41035	2.09023	-0.67442
24	28	4.21	784	1.43746	0.83110	-0.41948	2.08168	0.60636
25	29	1.37	841	0.31481	0.82418	-0.42673	2.07510	-0.50937
26	30	1.49	900	0.39878	0.81919	-0.43208	2.07047	-0.42042
27	31	3.04	961	1.11186	0.81613	-0.43552	2.06778	0.29573
28	32	1.84	1024	0.60977	0.81499	-0.43703	2.06701	-0.20522
29	33	2.18	1089	0.77932	0.81577	-0.43661	2.06815	-0.03644
30	34	1.45	1156	0.37156	0.81848	-0.43423	2.07118	-0.44691
31	35	1.23	1225	0.20701	0.82311	-0.42990	2.07611	-0.61609
32	36	1.98	1296	0.68310	0.82966	-0.42359	2.08292	-0.14657
33	37	1.05	1369	0.04879	0.83814	-0.41532	2.09160	-0.78935
34	38	3.00	1444	1.09861	0.84855	-0.40506	2.10216	0.25006
35	39	1.59	1521	0.46373	0.86088	-0.39283	2.11458	-0.39714
36	40	3.52	1600	1.25846	0.87513	-0.37860	2.12886	0.38333
37	41	0.64	1681	-0.44629	0.89131	-0.36240	2.14501	-1.33759
38	42	5.99	1764	1.79009	0.90941	-0.34420	2.16302	0.88068
39	43	0.50	1849	-0.69315	0.92943	-0.32403	2.18289	-1.62258
40	44	4.08	1936	1.40610	0.95138	-0.30188	2.20464	0.45471
41	45	1.18	2025	0.16551	0.97526	-0.27775	2.22826	-0.80974
42	46	5.43	2116	1.69194	1.00105	-0.25165	2.25376	0.69088

TABLE 12 (Cont'd)

Results Based on Regression of
LCAPL with AGE and AGE2

OBS	AGE	CAPL ($/kW)	AGE2	LCAPL	FITTED	LOWER	UPPER	RESIDUAL
43	47	1.23	2209	0.20701	1.02878	-0.22360	2.28115	-0.82176
44	48	1.68	2304	0.51879	1.05842	-0.19360	2.31045	-0.53963
45	49	10.85	2401	2.38417	1.09000	-0.16165	2.34165	1.29417
46	50	4.86	2500	1.58104	1.12349	-0.12779	2.37477	0.45755
47	51	2.30	2601	0.83291	1.15891	-0.09200	2.40983	-0.32600
48	52	2.20	2704	0.78846	1.19625	-0.05433	2.44684	-0.40780
49	53	10.86	2809	2.38509	1.23552	-0.01477	2.48581	1.14956
50	54	8.01	2916	2.08069	1.27672	0.02665	2.52678	0.80398
51	55	3.87	3025	1.35325	1.31983	0.06992	2.56975	0.03342
52	56	7.53	3136	2.01890	1.36487	0.11500	2.61474	0.65402
53	57	4.44	3249	1.49065	1.41184	0.16189	2.66179	0.07882
54	58	3.96	3364	1.37624	1.46073	0.21054	2.71091	-0.08448
55	59	3.13	3481	1.14103	1.51154	0.26095	2.76213	-0.37051
56	60	7.84	3600	2.05924	1.56428	0.31308	2.81548	0.49496
57	61	1.83	3721	0.60432	1.61894	0.36690	2.87098	-1.01463
58	62	8.74	3844	2.16791	1.67553	0.42239	2.92867	0.49238
59	63	10.87	3969	2.38601	1.73404	0.47951	2.98857	0.65197
60	64	17.30	4096	2.85071	1.79448	0.53824	3.05072	1.05623
61	65	5.76	4225	1.75094	1.85684	0.59853	3.11514	-0.10590
62	66	11.18	4356	2.41413	1.92112	0.66036	3.18188	0.49301
63	67	7.08	4489	1.95727	1.98733	0.72369	3.25096	-0.03005
64	68	5.88	4624	1.77156	2.05546	0.78849	3.32243	-0.28390
65	69	4.45	4761	1.49290	2.12552	0.85472	3.39632	-0.63261
66	70	6.44	4900	1.86253	2.19750	0.92234	3.47266	-0.33497
67	71	16.77	5041	2.81959	2.27140	0.99131	3.55150	0.54819
68	72	11.66	5184	2.45616	2.34723	1.06161	3.63286	0.10893
69	73	18.02	5329	2.89148	2.42499	1.13319	3.71678	0.46649
70	74	5.38	5476	1.68269	2.50467	1.20602	3.80331	-0.82198
71	75	5.69	5625	1.73871	2.58627	1.28006	3.89248	-0.84756

TABLE 13

Model: MODEL 1
Dependent Variable: COST

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	2824.01664	1412.00832	151.371	0.0001
Error	68	634.31235	9.32812		
C Total	70	3458.32898			

Root MSE	3.05420	R-square	0.8166
Dep Mean	14.41211	Adj R-sq	0.8112
C.V.	21.19188		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	10.803244	1.38887522	7.778	0.0001
AGE	1	-0.240442	0.07921320	-3.035	0.0034
AGE2	1	0.006548	0.00096517	6.784	0.0001

TABLE 14

Model: MODEL 1
Dependent Variable: LCOST

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	11.09717	5.54859	164.304	0.0001
Error	68	2.29638	0.03377		
C Total	70	13.39355			

Root MSE	0.18377	R-square	0.8285
Dep Mean	2.56746	Adj R-sq	0.8235
C.V.	7.15755		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	2.185981	0.08356674	26.159	0.0001
AGE	1	-0.005763	0.00476615	-1.209	0.2308
AGE2	1	0.000303	0.00005807	5.217	0.0001

TABLE 15

Model: MODEL 1
Dependent Variable: LCOST

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	11.04779	11.04779	324.968	0.0001
Error	69	2.34576	0.03400		
C Total	70	13.39355			

Root MSE	0.18438	R-square	0.8249
Dep Mean	2.56746	Adj R-sq	0.8223
C.V.	7.18148		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	2.093715	0.03419717	61.225	0.0001
AGE2	1	0.000235	0.00001301	18.027	0.0001

TABLE 16

Results Based on Regression of
LCOST with AGE2

OBS	AGE	COST ($/kW)	AGE2	LCOST	FITTED	LOWER	UPPER	RESIDUAL
1	5	9.11	25	2.20937	2.09958	1.72556	2.47359	0.10979
2	6	8.18	36	2.10169	2.10216	1.72818	2.47613	-0.00047
3	7	9.26	49	2.22570	2.10521	1.73128	2.47914	0.12050
4	8	8.11	64	2.09310	2.10873	1.73485	2.48260	-0.01563
5	9	8.80	81	2.17475	2.11271	1.73890	2.48653	0.06204
6	10	12.64	100	2.53687	2.11717	1.74342	2.49092	0.41970
7	11	5.73	121	1.74572	2.12209	1.74842	2.49577	-0.37638
8	12	9.03	144	2.20055	2.12749	1.75389	2.50109	0.07307
9	13	8.62	169	2.15409	2.13335	1.75983	2.50687	0.02073
10	14	10.09	196	2.31154	2.13968	1.76626	2.51311	0.17186
11	15	8.43	225	2.13180	2.14648	1.77315	2.51981	-0.01469
12	16	7.08	256	1.95727	2.15375	1.78052	2.52699	-0.19648
13	17	9.64	289	2.26592	2.16149	1.78837	2.53462	0.10443
14	18	7.98	324	2.07694	2.16970	1.79668	2.54272	-0.09276
15	19	7.38	361	1.99877	2.17838	1.80547	2.55129	-0.17961
16	20	8.54	400	2.14476	2.18753	1.81473	2.56032	-0.04276
17	21	11.93	441	2.47906	2.19714	1.82447	2.56981	0.28192
18	22	8.84	484	2.17929	2.20723	1.83467	2.57978	-0.02794
19	23	10.64	529	2.36462	2.21778	1.84535	2.59021	0.14684
20	24	10.31	576	2.33311	2.22880	1.85650	2.60111	0.10431
21	25	9.65	625	2.26696	2.24029	1.86812	2.61247	0.02666
22	26	11.54	676	2.44582	2.25225	1.88020	2.62431	0.19356
23	27	8.74	729	2.16791	2.26468	1.89276	2.63661	-0.09677
24	28	11.91	784	2.47738	2.27758	1.90578	2.64938	0.19980
25	29	9.67	841	2.26903	2.29095	1.91928	2.66263	-0.02192
26	30	8.90	900	2.18605	2.30479	1.93324	2.67634	-0.11874
27	31	9.66	961	2.26799	2.31909	1.94766	2.69053	-0.05110
28	32	9.07	1024	2.20497	2.33387	1.96256	2.70518	-0.12890
29	33	11.78	1089	2.46640	2.34911	1.97791	2.72031	0.11729
30	34	8.23	1156	2.10779	2.36483	1.99374	2.73592	-0.25704
31	35	8.68	1225	2.16102	2.38101	2.01002	2.75200	-0.21999
32	36	9.70	1296	2.27213	2.39766	2.02677	2.76855	-0.12553
33	37	9.61	1369	2.26280	2.41478	2.04398	2.78558	-0.15198
34	38	11.24	1444	2.41948	2.43237	2.06166	2.80308	-0.01289
35	39	11.24	1521	2.41948	2.45043	2.07979	2.82107	-0.03095
36	40	13.10	1600	2.57261	2.46896	2.09838	2.83953	0.10366
37	41	10.36	1681	2.33795	2.48795	2.11743	2.85847	-0.15000
38	42	14.78	1764	2.69327	2.50742	2.13695	2.87789	0.18586
39	43	9.26	1849	2.22570	2.52735	2.15691	2.89779	-0.30165
40	44	15.82	1936	2.76127	2.54776	2.17734	2.91818	0.21352
41	45	9.04	2025	2.20166	2.56863	2.19822	2.93904	-0.36697
42	46	13.25	2116	2.58400	2.58997	2.21955	2.96039	-0.00597
43	47	10.20	2209	2.32239	2.61178	2.24134	2.98223	-0.28939
44	48	11.24	2304	2.41948	2.63406	2.26357	3.00455	-0.21458

TABLE 16 (Cont'd)

Results Based on Regression of
LCOST with AGE2

OBS	AGE	COST	AGE2	LCOST	FITTED	LOWER	UPPER	RESIDUAL
45	49	20.78	2401	3.03399	2.65681	2.28627	3.02736	0.37718
46	50	14.48	2500	2.67277	2.68003	2.30941	3.05065	-0.00726
47	51	12.12	2601	2.49486	2.70372	2.33300	3.07443	-0.20886
48	52	12.58	2704	2.53211	2.72787	2.35703	3.09871	-0.19576
49	53	21.31	2809	3.05918	2.75250	2.38152	3.12348	0.30668
50	54	19.91	2916	2.99122	2.77759	2.40645	3.14873	0.21363
51	55	14.88	3025	2.70002	2.80315	2.43182	3.17448	-0.10314
52	56	18.92	3136	2.94022	2.82919	2.45764	3.20073	0.11103
53	57	16.06	3249	2.77633	2.85569	2.48390	3.22747	-0.07936
54	58	16.80	3364	2.82138	2.88266	2.51061	3.25471	-0.06128
55	59	16.46	3481	2.80093	2.91010	2.53775	3.28245	-0.10916
56	60	22.01	3600	3.09150	2.93801	2.56533	3.31068	0.15349
57	61	16.75	3721	2.81840	2.96638	2.59335	3.33942	-0.14799
58	62	22.58	3844	3.11706	2.99523	2.62180	3.36866	0.12183
59	63	25.85	3969	3.25231	3.02455	2.65069	3.39840	0.22777
60	64	33.02	4096	3.49711	3.05433	2.68002	3.42864	0.44278
61	65	21.07	4225	3.04785	3.08458	2.70978	3.45939	-0.03673
62	66	26.10	4356	3.26194	3.11531	2.73996	3.49065	0.14663
63	67	21.47	4489	3.06666	3.14650	2.77058	3.52241	-0.07984
64	68	22.15	4624	3.09784	3.17816	2.80163	3.55469	-0.08032
65	69	20.95	4761	3.04214	3.21029	2.83311	3.58747	-0.16815
66	70	22.89	4900	3.13070	3.24289	2.86501	3.62077	-0.11219
67	71	33.78	5041	3.51987	3.27596	2.89734	3.65458	0.24391
68	72	30.22	5184	3.40850	3.30949	2.93009	3.68890	0.09901
69	73	34.89	5329	3.55220	3.34350	2.96326	3.72374	0.20870
70	74	23.20	5476	3.14415	3.37797	2.99686	3.75909	-0.23382
71	75	25.02	5625	3.21968	3.41292	3.03087	3.79497	-0.19324

APPENDIX A

Figure A.1

Plot of RESIDUAL*FITTED. Legend: A = 1 obs, B = 2 obs, etc.

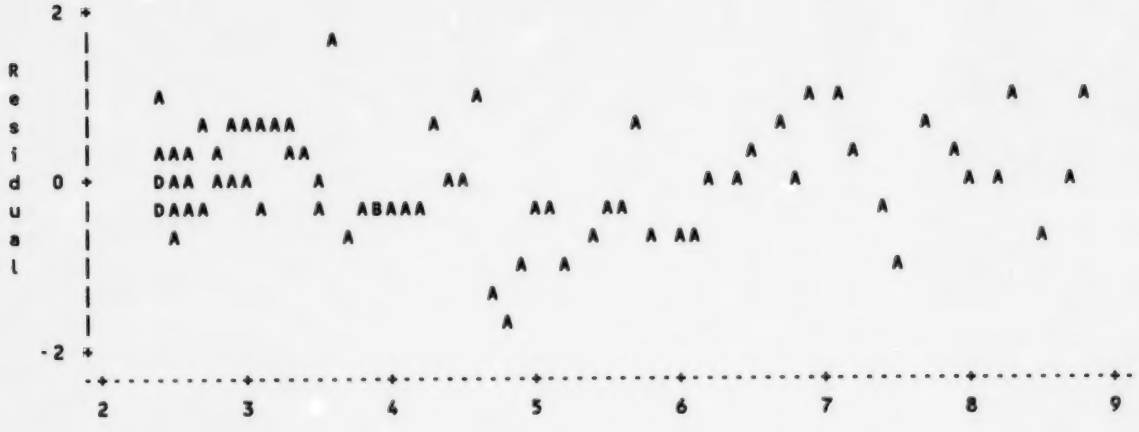
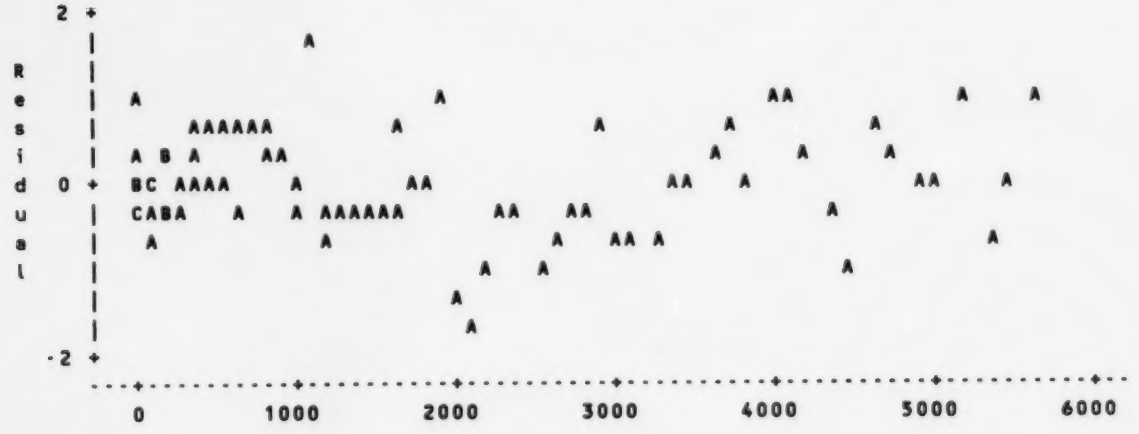


Figure A.2

Plot of RESIDUAL*AGE2. Legend: A = 1 obs, B = 2 obs, etc.

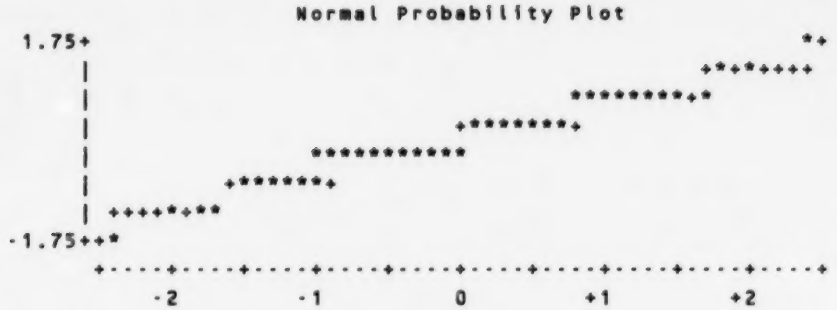


APPENDIX A

Figure A.3

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual



APPENDIX A

Table A.1

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual

Moments

N	76	Sum Wgts	76
Mean	0	Sum	0
Std Dev	0.606378	Variance	0.367694
Skewness	0.162048	Kurtosis	0.353449
USS	27.57707	CSS	27.57707
CV	.	Std Mean	0.069556
T:Mean=0	0	Prob>|T|	1.0000
Sgn Rank	-46	Prob>|S|	0.8136
Num ^= 0	76		
W:Normal	0.987664	Prob<W	0.9152

Variable=RESIDUAL Residual

Quantiles(Def=5)

100% Max	1.788436	99%	1.788436
75% Q3	0.327815	95%	0.970307
50% Med	-0.08848	90%	0.81483
25% Q1	-0.3684	10%	-0.68945
0% Min	-1.57756	5%	-1.01496
		1%	-1.57756
Range	3.365995		
Q3-Q1	0.696212		
Mode	-1.57756		

Variable=RESIDUAL Residual

Extremes

Lowest	Obs	Highest	Obs
-1.57756(	47)	0.965907(	65)
-1.33247(	46)	0.970307(	45)
-1.03794(	68)	1.007159(	6)
-1.01496(	48)	1.079468(	73)
-0.92101(	51)	1.788436(	34)

APPENDIX B

Figure B.1

Plot of RESIDUAL*FITTED. Legend: A = 1 obs, B = 2 obs, etc.

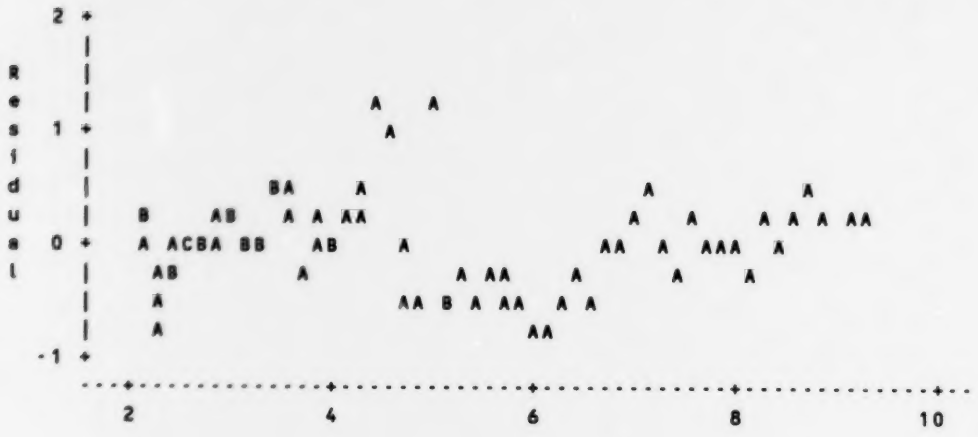
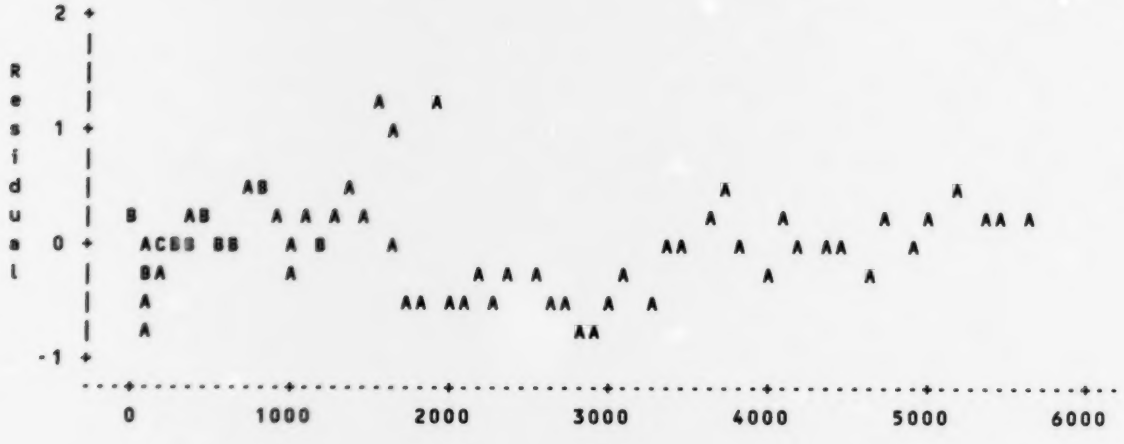


Figure B.2

Plot of RESIDUAL*AGE2. Legend: A = 1 obs, B = 2 obs, etc.

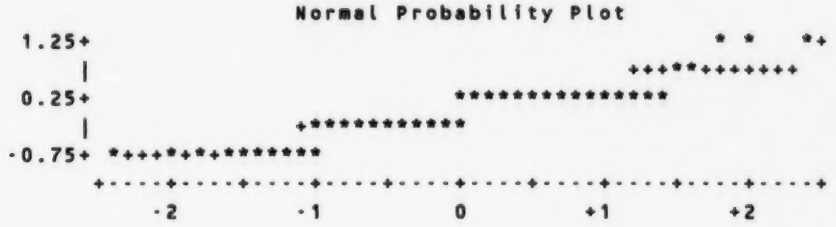


APPENDIX B

Figure B.3

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual



APPENDIX B

Figure B.4

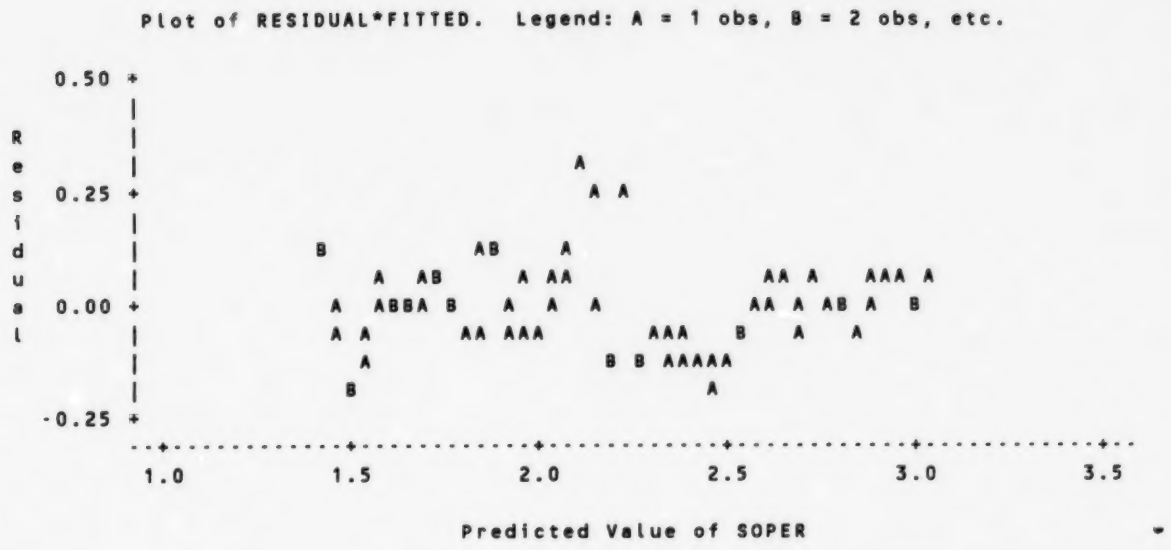
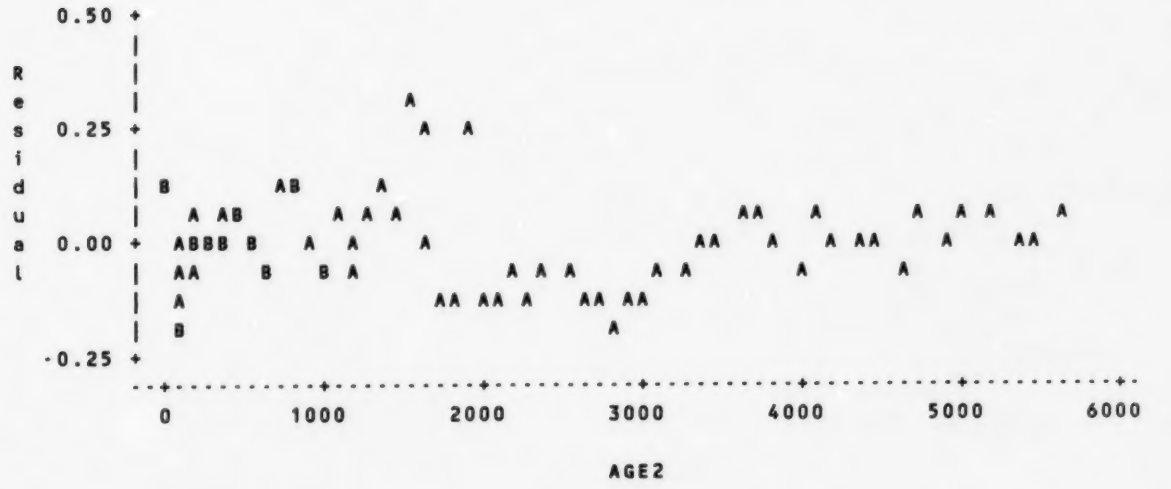


Figure B.5

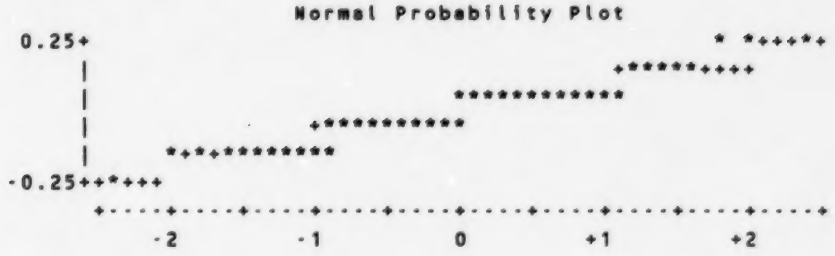


APPENDIX B

Figure B.6

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual



APPENDIX B

Table B.1

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual

Moments

N	71	Sum Wgts	71
Mean	0	Sum	0
Std Dev	0.417814	Variance	0.174569
Skewness	0.713852	Kurtosis	1.438259
USS	12.21981	CSS	12.21981
CV	.	Std Mean	0.049585
T:Mean=0	0	Prob>|T|	1.0000
Sgn Rank	-50	Prob>|S|	0.7768
Num ^= 0	71		
W:Normal	0.95182	Prob<W	0.0211

Variable=RESIDUAL Residual

Quantiles(Def=5)

100% Max	1.348316	99%	1.348316
75% Q3	0.205874	95%	0.615879
50% Med	-0.0041	90%	0.406211
25% Q1	-0.28511	10%	-0.5652
0% Min	-0.83034	5%	-0.59608
		1%	-0.83034
Range	2.178652		
Q3-Q1	0.490987		
Mode	-0.83034		

Variable=RESIDUAL Residual

Extremes

Lowest	Obs	Highest	Obs
-0.83034(	49)	0.594498(	33)
-0.65494(	6)	0.615879(	25)
-0.63685(	50)	1.057474(	36)
-0.59608(	42)	1.20577(	40)
-0.58527(	44)	1.348316(	35)

APPENDIX B

Table B.2

LOG LIKELIHOOD FUNCTION VALUES
FOR SELECTED VALUES OF a

a	L(a)
0	-91.32
0.5	-86.64
1	-88.56

APPENDIX B

Table B.3

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual

Moments

N	71	Sum Wgts	71
Mean	0	Sum	0
Std Dev	0.095821	Variance	0.009182
Skewness	0.493749	Kurtosis	0.996289
USS	0.642713	CSS	0.642713
CV	.	Std Mean	0.011372
T:Mean=0	0	Prob>|T|	1.0000
Sgn Rank	-39	Prob>|S|	0.8250
Num ^= 0	71		
W:Normal	0.971353	Prob<W	0.2829

Variable=RESIDUAL Residual

Quantiles(Def=5)

100% Max	0.294195	99%	0.294195
75% Q3	0.05443	95%	0.148583
50% Med	0.00167	90%	0.111858
25% Q1	-0.06293	10%	-0.12104
0% Min	-0.21566	5%	-0.13434
		1%	-0.21566
Range	0.509851		
Q3-Q1	0.117359		
Mode	-0.21566		

Variable=RESIDUAL Residual

Extremes

Lowest	Obs	Highest	Obs
-0.21566(	6)	0.133953(	33)
-0.17099(	49)	0.148583(	25)
-0.16638(	5)	0.231296(	36)
-0.13434(	42)	0.254733(	40)
-0.13377(	41)	0.294195(	35)

APPENDIX C

Figure C.1

Plot of RESIDUAL*FITTED. Legend: A = 1 obs, B = 2 obs, etc.

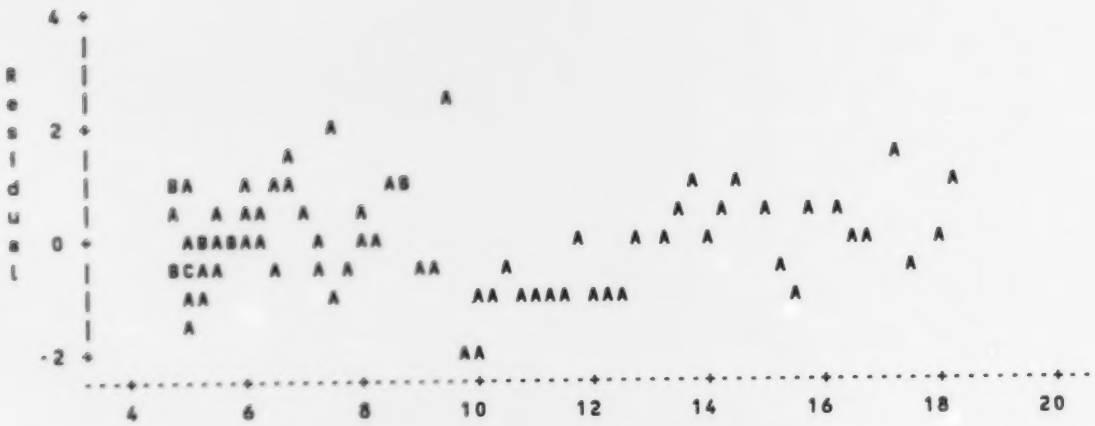
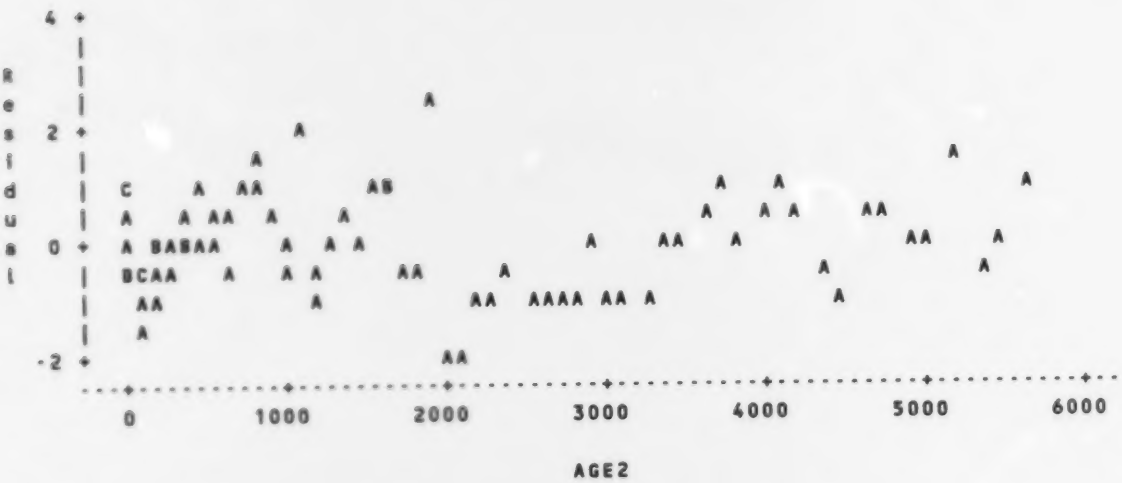


Figure C.2

Plot of RESIDUAL*AGE2. Legend: A = 1 obs, B = 2 obs, etc.

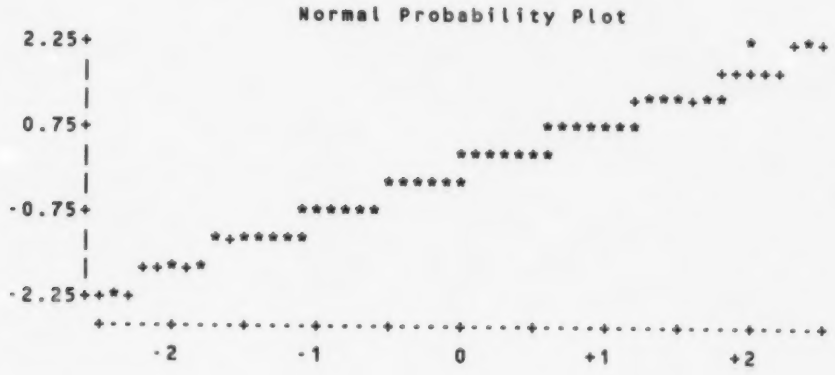


APPENDIX C

Figure C.3

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual



APPENDIX C

Table C.1

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual

Moments

N	76	Sum Wgts	76
Mean	0	Sum	0
Std Dev	0.870899	Variance	0.758465
Skewness	0.14476	Kurtosis	-0.02049
USS	56.88486	CSS	56.88486
CV	.	Std Mean	0.099899
T:Mean=0	0	Prob>|T|	1.0000
Sgn Rank	-18	Prob>|S|	0.9265
Num ^= 0	76		
W:Normal	0.985329	Prob<W	0.8402

Variable=RESIDUAL Residual

Quantiles(Def=5)

100% Max	2.286048	99%	2.286048
75% Q3	0.645479	95%	1.351428
50% Med	-0.02813	90%	1.068538
25% Q1	-0.65945	10%	-1.08824
0% Min	-2.0637	5%	-1.22164
		1%	-2.0637
Range	4.349751		
Q3-Q1	1.30493		
Mode	-2.0637		

Variable=RESIDUAL Residual

Extremes

Lowest	Obs	Highest	Obs
-2.0637(	47)	1.20435(	62)
-1.80644(	46)	1.351428(	73)
-1.62049(	11)	1.460367(	30)
-1.22164(	52)	2.168266(	34)
-1.18051(	51)	2.286048(	45)

APPENDIX D

Table D.1

Model: MODEL 1
Dependent Variable: CAPL

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	537.69155	268.84578	7.192	0.0015
Error	68	2541.89828	37.38086		
C Total	70	3079.58983			

Root MSE	6.11399	R-square	0.1746
Dep Mean	5.94901	Adj R-sq	0.1503
C.V.	102.77314		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	4.931585	2.78029406	1.774	0.0806
AGE	1	-0.137431	0.15857147	-0.867	0.3892
AGE2	1	0.003225	0.00193210	1.669	0.0997

APPENDIX D

Table D.2

Results from the Outlier Test

OBS	AGE	CAPL ($/kW)	AGE2	RSTUDENT
1	5	3.40	25	-0.16012
2	6	3.14	36	-0.18612
3	7	4.92	49	0.13527
4	8	3.57	64	-0.07952
5	9	4.86	81	0.15268
6	10	9.19	100	0.89803
7	11	1.32	121	-0.41751
8	12	4.61	144	0.14408
9	13	3.36	169	-0.05492
10	14	4.70	196	0.17604
11	15	3.39	225	-0.03408
12	16	1.67	256	-0.31244
13	17	4.42	289	0.14741
14	18	1.98	324	-0.25123
15	19	1.52	361	-0.32393
16	20	2.59	400	-0.14540
17	21	5.15	441	0.27697
18	22	2.64	484	-0.13639
19	23	3.80	529	0.05317
20	24	4.01	576	0.08537
21	25	2.74	625	-0.12689
22	26	5.39	676	0.30473
23	27	1.18	729	-0.39397
24	28	4.21	784	0.09841
25	29	1.37	841	-0.37706
26	30	28.10	900	4.60810
27	31	3.04	961	-0.12033
28	32	1.84	1024	-0.32915
29	33	2.18	1089	-0.28502
30	34	1.45	1156	-0.41878
31	35	1.23	1225	-0.46941
32	36	1.98	1296	-0.36050
33	37	1.05	1369	-0.53090
34	38	3.00	1444	-0.22547
35	39	1.59	1521	-0.47714
36	40	3.52	1600	-0.17732
37	41	0.64	1681	-0.67514
38	42	5.99	1764	0.18836
39	43	0.50	1849	-0.74288
40	44	4.08	1936	-0.17294
41	45	1.18	2025	-0.67802
42	46	5.43	2116	-0.00067

Table D.2 (Cont'd)

Results from the Outlier Test

OBS	AGE	CAPL	AGE2	RSTUDENT
43	47	1.23	2209	-0.72240
44	48	1.68	2304	-0.67537
45	49	10.85	2401	0.81249
46	50	4.86	2500	-0.20797
47	51	2.30	2601	-0.66236
48	52	2.20	2704	-0.71118
49	53	10.86	2809	0.68560
50	54	8.01	2916	0.18020
51	55	3.87	3025	-0.53708
52	56	7.53	3136	0.02971
53	57	4.44	3249	-0.51683
54	58	20.56	3364	2.16977
55	59	3.13	3481	-0.81352
56	60	7.84	3600	-0.07508
57	61	41.87	3721	7.40104
58	62	8.74	3844	-0.01123
59	63	10.87	3969	0.29675
60	64	17.30	4096	1.33245
61	65	5.76	4225	-0.64207
62	66	11.18	4356	0.21094
63	67	7.08	4489	-0.52040
64	68	5.88	4624	-0.77430
65	69	4.45	4761	-1.07301
66	70	6.44	4900	-0.78943
67	71	16.77	5041	0.90693
68	72	11.66	5184	-0.01619
69	73	18.02	5329	1.02078
70	74	5.38	5476	-1.22329
71	75	5.69	5625	-1.23837

APPENDIX D

Table D.3

Model: MODEL 1
Dependent Variable: CAPL

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	465.55199	232.77600	19.606	0.0001
Error	68	807.33700	11.87260		
C Total	70	1272.88899			

Root MSE	3.44566	R-square	0.3657
Dep Mean	5.01028	Adj R-sq	0.3471
C.V.	68.77187		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	5.668147	1.56689205	3.617	0.0006
AGE	1	-0.218017	0.08936622	-2.440	0.0173
AGE2	1	0.003991	0.00108888	3.666	0.0005

APPENDIX D

Table D.4

Results from the Outlier Test

OBS	AGE	CAPL	AGE2	RSTUDENT
1	5	3.40	25	-0.39284
2	6	3.14	36	-0.41626
3	7	4.92	49	0.17643
4	8	3.57	64	-0.18358
5	9	4.86	81	0.24900
6	10	9.19	100	1.61216
7	11	1.32	121	-0.72573
8	12	4.61	144	0.29136
9	13	3.36	169	-0.04384
10	14	4.70	196	0.38382
11	15	3.39	225	0.02763
12	16	1.67	256	-0.45005
13	17	4.42	289	0.38260
14	18	1.98	324	-0.30953
15	19	1.52	361	-0.42350
16	20	2.59	400	-0.09185
17	21	5.15	441	0.67381
18	22	2.64	484	-0.04777
19	23	3.80	529	0.30216
20	24	4.01	576	0.37248
21	25	2.74	625	0.00805
22	26	5.39	676	0.78931
23	27	1.18	729	-0.44185
24	28	4.21	784	0.44358
25	29	1.37	841	-0.38961
26	30	1.49	900	-0.35968
27	31	3.04	961	0.08608
28	32	1.84	1024	-0.27462
29	33	2.18	1089	-0.18729
30	34	1.45	1156	-0.41581
31	35	1.23	1225	-0.49746
32	36	1.98	1296	-0.29649
33	37	1.05	1369	-0.59156
34	38	3.00	1444	-0.04310
35	39	1.59	1521	-0.48286
36	40	3.52	1600	0.05450
37	41	0.64	1681	-0.82358
38	42	5.99	1764	0.71627
39	43	0.50	1849	-0.93494
40	44	4.08	1936	0.08108
41	45	1.18	2025	-0.81151
42	46	5.43	2116	0.39376
43	47	1.23	2209	-0.88489
44	48	1.68	2304	-0.79884

Table D.4 (Cont'd)

Results from the Outlier Test

OBS	AGE	CAPL	AGE2	RSTUDENT
45	49	10.85	2401	1.88356
46	50	4.86	2500	0.03330
47	51	2.30	2601	-0.77186
48	52	2.20	2704	-0.85850
49	53	10.86	2809	1.64801
50	54	8.01	2916	0.72532
51	55	3.87	3025	-0.55028
52	56	7.53	3136	0.45401
53	57	4.44	3249	-0.51742
54	58	20.56	3364	4.76530
55	59	3.13	3481	-1.05078
56	60	7.84	3600	0.25823
57	61	1.83	3721	-1.60617
58	62	8.74	3844	0.36484
59	63	10.87	3969	0.91222
60	64	17.30	4096	2.87151
61	65	5.76	4225	-0.76782
62	66	11.18	4356	0.74350
63	67	7.08	4489	-0.56196
64	68	5.88	4624	-1.02048
65	69	4.45	4761	-1.56659
66	70	6.44	4900	-1.06032
67	71	16.77	5041	1.99200
68	72	11.66	5184	0.30049
69	73	18.02	5329	2.19381
70	74	5.38	5476	-1.88053
71	75	5.69	5625	-1.91721

APPENDIX D

Table D.7

Results from the Outlier Test

OBS	AGE	CAPL	AGE2	RSTUDENT
1	5	3.40	25	-0.54033
2	6	3.14	36	-0.55934
3	7	4.92	49	0.13238
4	8	3.57	64	-0.27529
5	9	4.86	81	0.23077
6	10	9.19	100	1.81770
7	11	1.32	121	-0.88093
8	12	4.61	144	0.30017
9	13	3.36	169	-0.07980
10	14	4.70	196	0.41969
11	15	3.39	225	0.01514
12	16	1.67	256	-0.52987
13	17	4.42	289	0.43653
14	18	1.98	324	-0.35589
15	19	1.52	361	-0.48171
16	20	2.59	400	-0.09358
17	21	5.15	441	0.79577
18	22	2.64	484	-0.03195
19	23	3.80	529	0.37691
20	24	4.01	576	0.46325
21	25	2.74	625	0.04782
22	26	5.39	676	0.95575
23	27	1.18	729	-0.46114
24	28	4.21	784	0.56503
25	29	1.37	841	-0.39151
26	30	1.49	900	-0.35247
27	31	3.04	961	0.16585
28	32	1.84	1024	-0.24568
29	33	2.18	1089	-0.14082
30	34	1.45	1156	-0.40009
31	35	1.23	1225	-0.49019
32	36	1.98	1296	-0.25469
33	37	1.05	1369	-0.59098
34	38	3.00	1444	0.04480
35	39	1.59	1521	-0.45843
36	40	3.52	1600	0.16434
37	41	0.64	1681	-0.84444
38	42	5.99	1764	0.93677
39	43	0.50	1849	-0.96654
40	44	4.08	1936	0.20765
41	45	1.18	2025	-0.81816
42	46	5.43	2116	0.57461
43	47	1.23	2209	-0.89729
44	48	1.68	2304	-0.79549
45	49	10.85	2401	2.33306
46	50	4.86	2500	0.16808
47	51	2.30	2601	-0.75734
48	52	2.20	2704	-0.85507
49	53	10.86	2809	2.06106
50	54	8.01	2916	0.97778
51	55	3.87	3025	-0.49424

Table D.7 (Cont'd)

Results from the Outlier Test

OBS	AGE	CAPL	AGE2	RSTUDENT
52	56	7.53	3136	0.66622
53	57	4.44	3249	-0.45307
54	58	3.96	3364	-0.69611
55	59	3.13	3481	-1.06457
56	60	7.84	3600	0.44555
57	61	1.83	3721	-1.70438
58	62	8.74	3844	0.57142
59	63	10.87	3969	1.20921
60	64	17.30	4096	3.57493
61	65	5.76	4225	-0.73124
62	66	11.18	4356	1.01546
63	67	7.08	4489	-0.49234
64	68	5.88	4624	-1.01951
65	69	4.45	4761	-1.64985
66	70	6.44	4900	-1.06373
67	71	16.77	5041	2.49877
68	72	11.66	5184	0.50632
69	73	18.02	5329	2.74561
70	74	5.38	5476	-2.01040
71	75	5.69	5625	-2.05224

APPENDIX D

Table D.8

LOG LIKELIHOOD FUNCTION VALUES
FOR SELECTED VALUES OF a

a	L(a)
0	-206.52
0.5	-209.64
1	-227.64

APPENDIX D

Table D.9

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual

Moments

N	71	Sum Wgts	71
Mean	0	Sum	0
Std Dev	0.60966	Variance	0.371685
Skewness	-0.19754	Kurtosis	-0.3129
USS	26.01794	CSS	26.01794
CV	.	Std Mean	0.072353
T:Mean=0	0	Prob>|T|	1.0000
Sgn Rank	27	Prob>|S|	0.8783
Num ^= 0	71		
W:Normal	0.982651	Prob<W	0.7450

Variable=RESIDUAL Residual

Quantiles(Def=5)

100% Max	1.29417	99%	1.29417
75% Q3	0.466495	95%	0.933508
50% Med	0.033422	90%	0.705618
25% Q1	-0.42042	10%	-0.80974
0% Min	-1.62258	5%	-0.96542
		1%	-1.62258
Range	2.916749		
Q3-Q1	0.886913		
Mode	-1.62258		

Variable=RESIDUAL Residual

Extremes

Lowest	Obs	Highest	Obs
-1.62258(	39)	0.880685(	38)
-1.33759(	37)	0.933508(	6)
-1.01463(	57)	1.05623(	60)
-0.96542(	7)	1.149563(	49)
-0.84756(	71)	1.29417(	45)

US HYDRAULIC UTILITIES
CAPITAL MODIFICATIONS

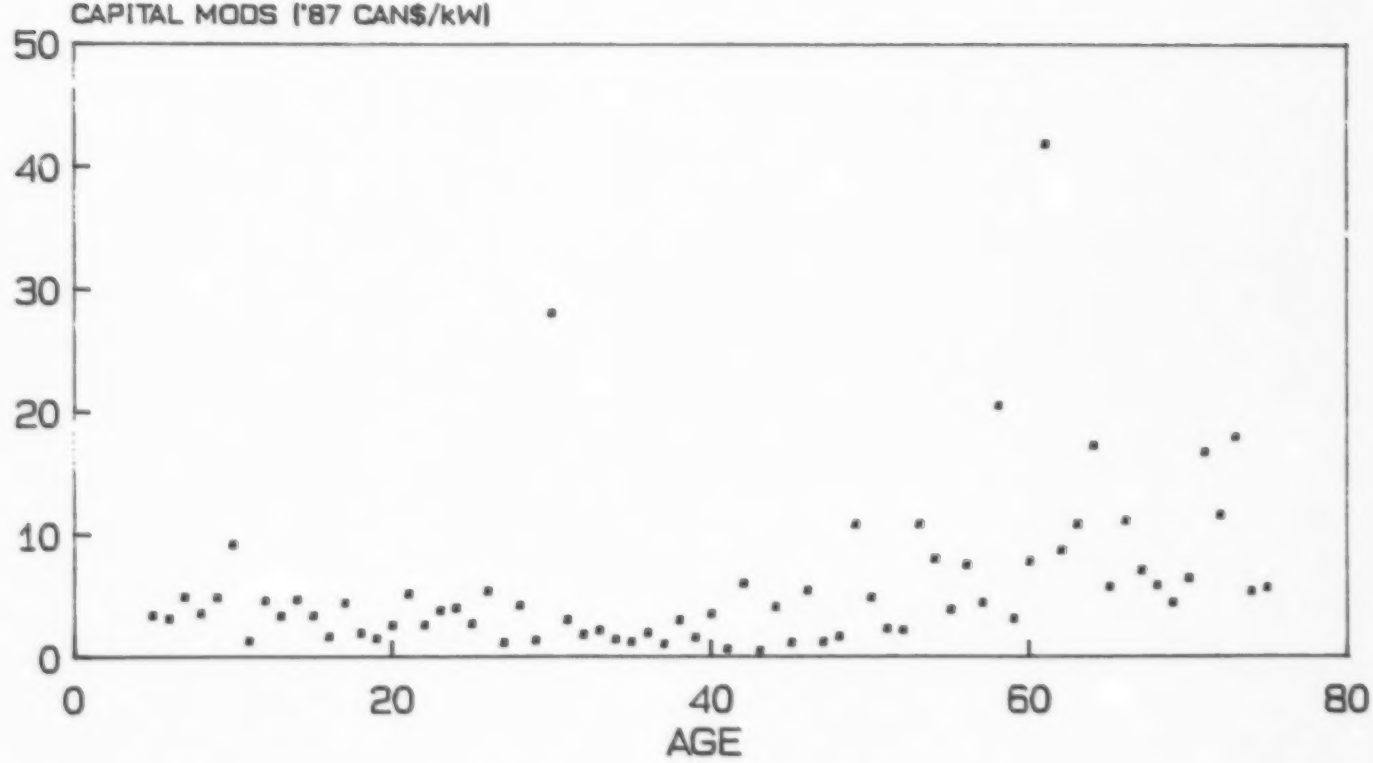


Figure D.1

APPENDIX D

Figure D.5

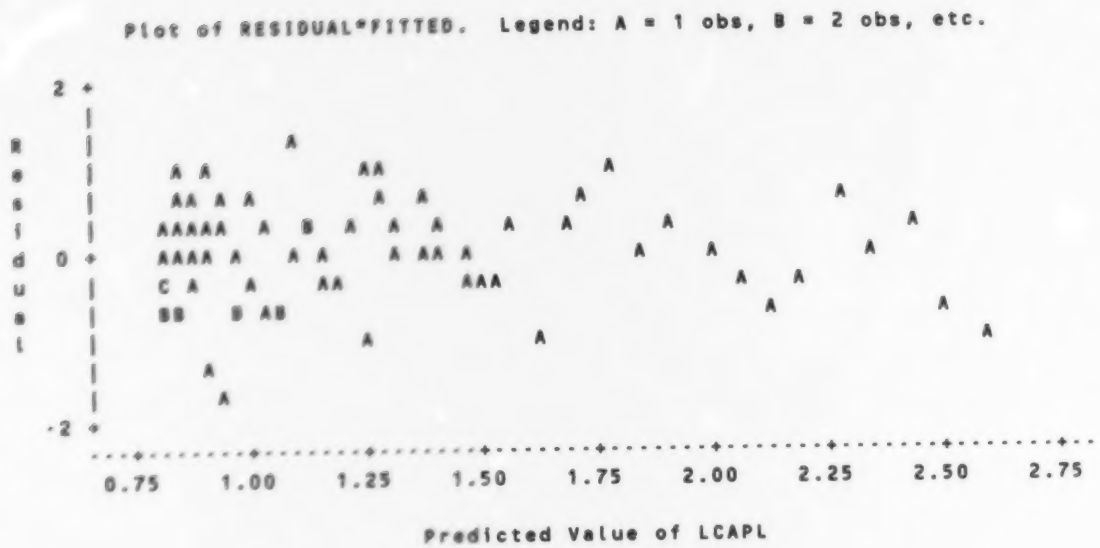
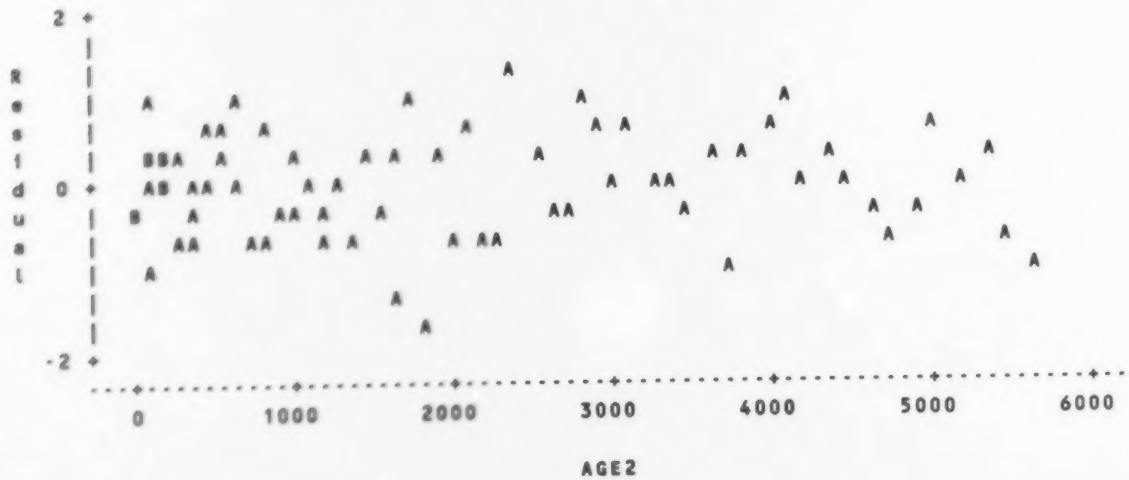


Figure D.6

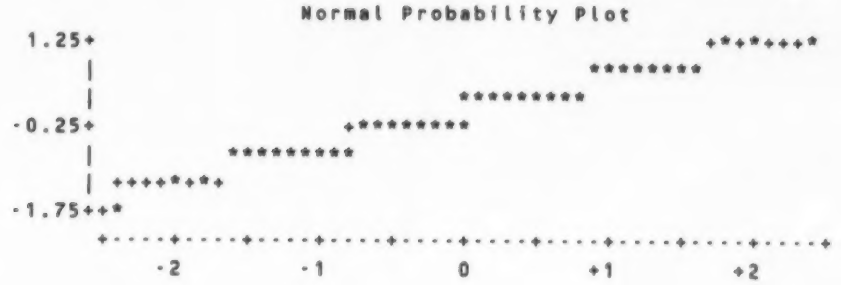


APPENDIX D

Figure D.7

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual



APPENDIX E

Table E.1

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual

Moments

N	71	Sum Wgts	71
Mean	0	Sum	0
Std Dev	3.01025	Variance	9.061605
Skewness	0.910197	Kurtosis	1.527078
USS	634.3123	CSS	634.3123
CV	.	Std Mean	0.357251
T:Mean=0	0	Prob>|T|	1.0000
Sgn Rank	-121	Prob>|S|	0.4920
Num ^= 0	71		
W:Normal	0.956601	Prob<W	0.0424

Variable=RESIDUAL Residual

Quantiles(Def=5)

100% Max	10.78527	99%	10.78527
75% Q3	1.78079	95%	6.037155
50% Med	-0.34466	90%	3.288458
25% Q1	-2.08439	10%	-3.4255
0% Min	-5.66626	5%	-4.20264
		1%	-5.66626
Range	16.45154		
Q3-Q1	3.865184		
Mode	-5.66626		

Variable=RESIDUAL Residual

Extremes

Lowest	Obs	Highest	Obs
-5.66626(	70)	4.857422(	49)
-4.58144(	71)	6.037155(	45)
-4.4368(	65)	6.74582(	69)
-4.20264(	41)	7.040701(	67)
-3.76655(	43)	10.78527(	60)

APPENDIX E

Table E.2

LOG LIKELIHOOD FUNCTION VALUES
FOR SELECTED VALUES OF a

a	L(a)
0	-211.81
0.5	-217.03
1	-229.07

APPENDIX E

Table E.3

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual

Moments

N	71	Sum Wgts	71
Mean	0	Sum	0
Std Dev	0.18306	Variance	0.033511
Skewness	0.239357	Kurtosis	-0.34035
USS	2.34576	CSS	2.34576
CV	.	Std Mean	0.021725
T:Mean=0	0	Prob>|T|	1.0000
Sgn Rank	-32	Prob>|S|	0.8560
Num ^= 0	71		
W:Normal	0.976035	Prob<W	0.4534

Variable=RESIDUAL Residual

Quantiles(Def=5)

100% Max	0.442783	99%	0.442783
75% Q3	0.121835	95%	0.30668
50% Med	-0.01563	90%	0.213632
25% Q1	-0.1289	10%	-0.21458
0% Min	-0.37638	5%	-0.28939
		1%	-0.37638
Range	0.819161		
Q3-Q1	0.250732		
Mode	-0.37638		

Variable=RESIDUAL Residual

Extremes

Lowest	Obs	Highest	Obs
-0.37638(	7)	0.281915(	17)
-0.36697(	41)	0.30668(	49)
-0.30165(	39)	0.377181(	45)
-0.28939(	43)	0.419698(	6)
-0.25704(	30)	0.442783(	60)

APPENDIX E

Figure E.1

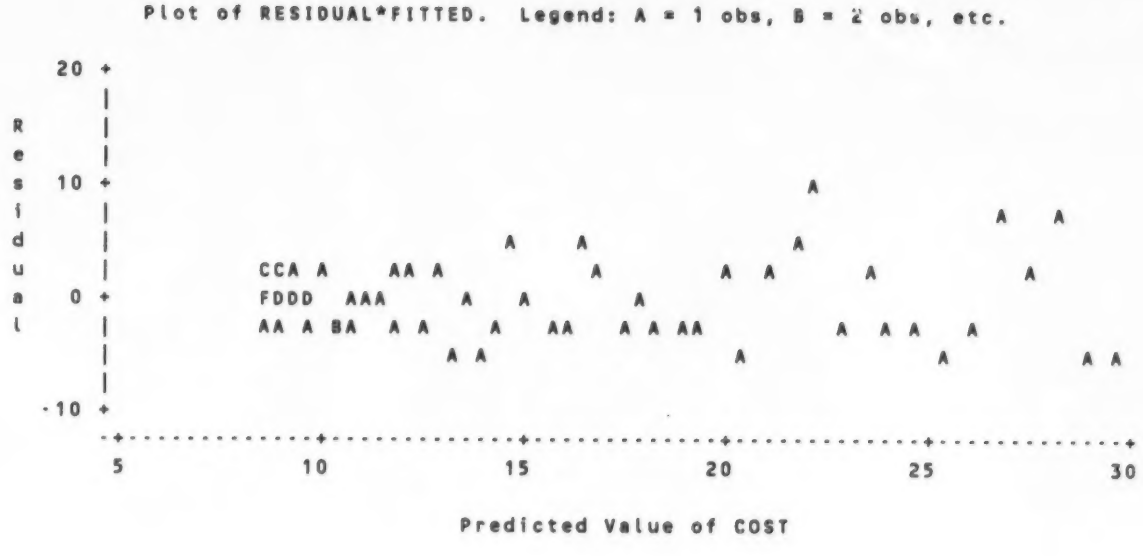
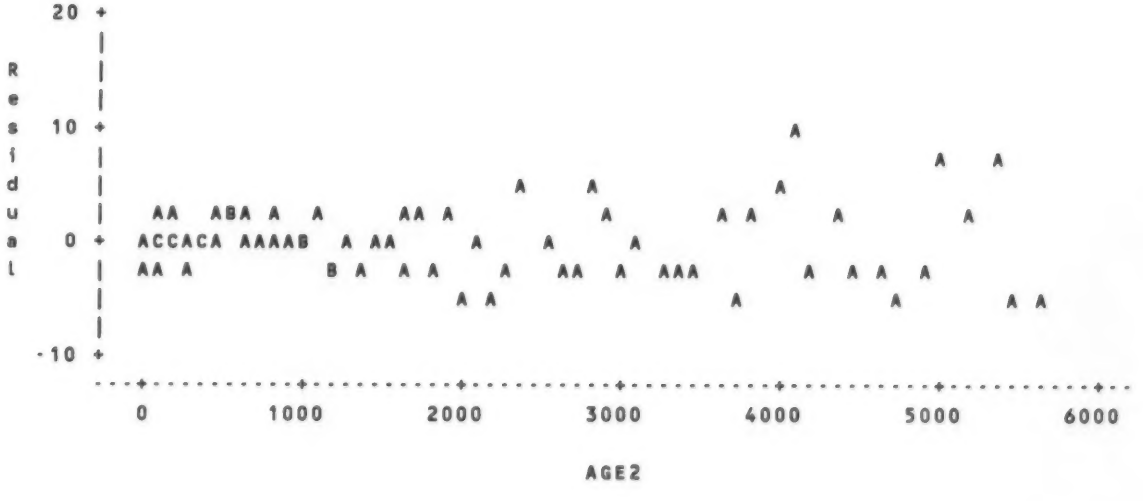


Figure E.2

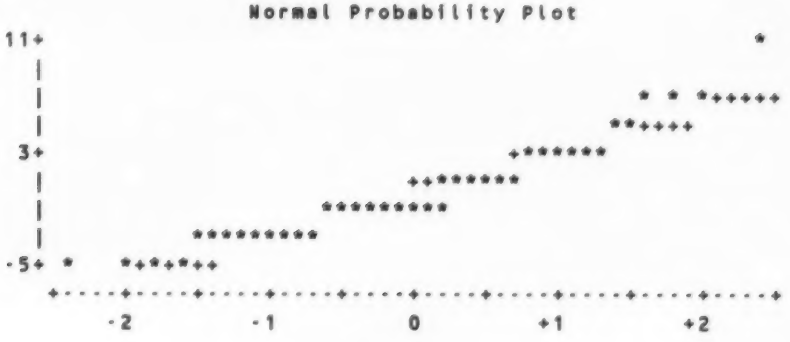


APPENDIX E

Figure E.3

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual



APPENDIX E

Figure E.4

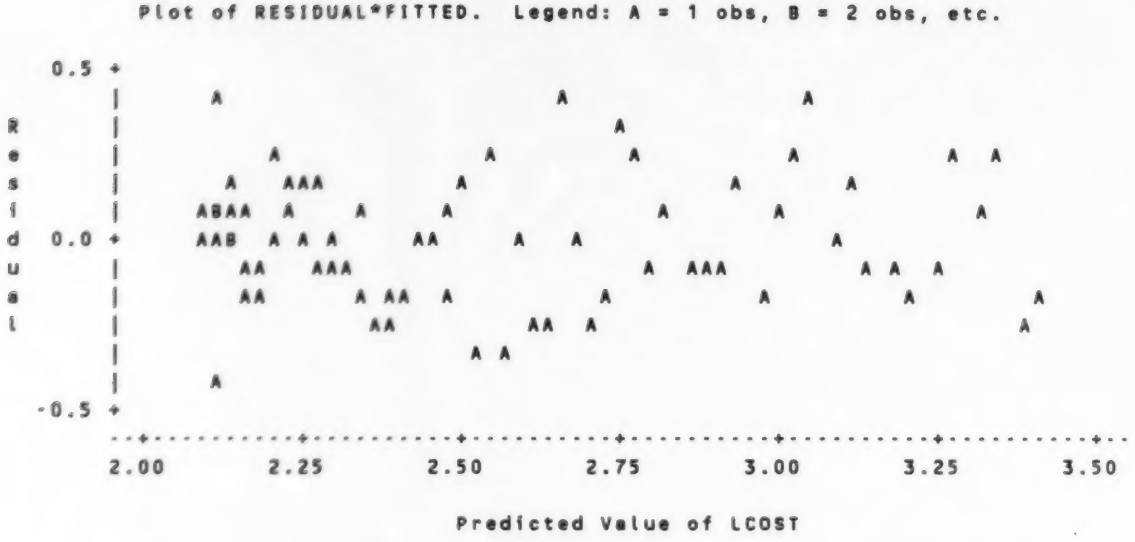
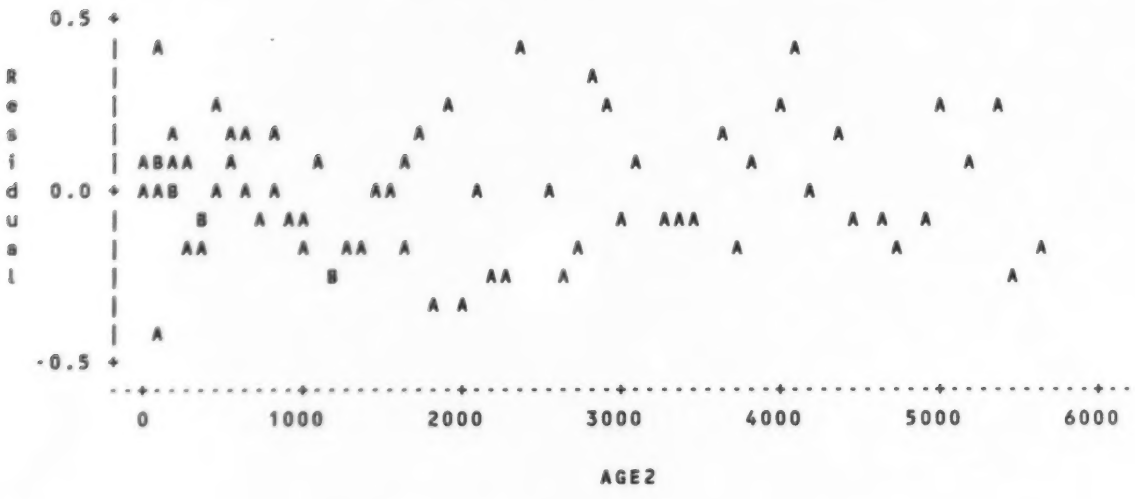


Figure E.5



APPENDIX E

Figure E.6

UNIVARIATE PROCEDURE

Variable=RESIDUAL Residual